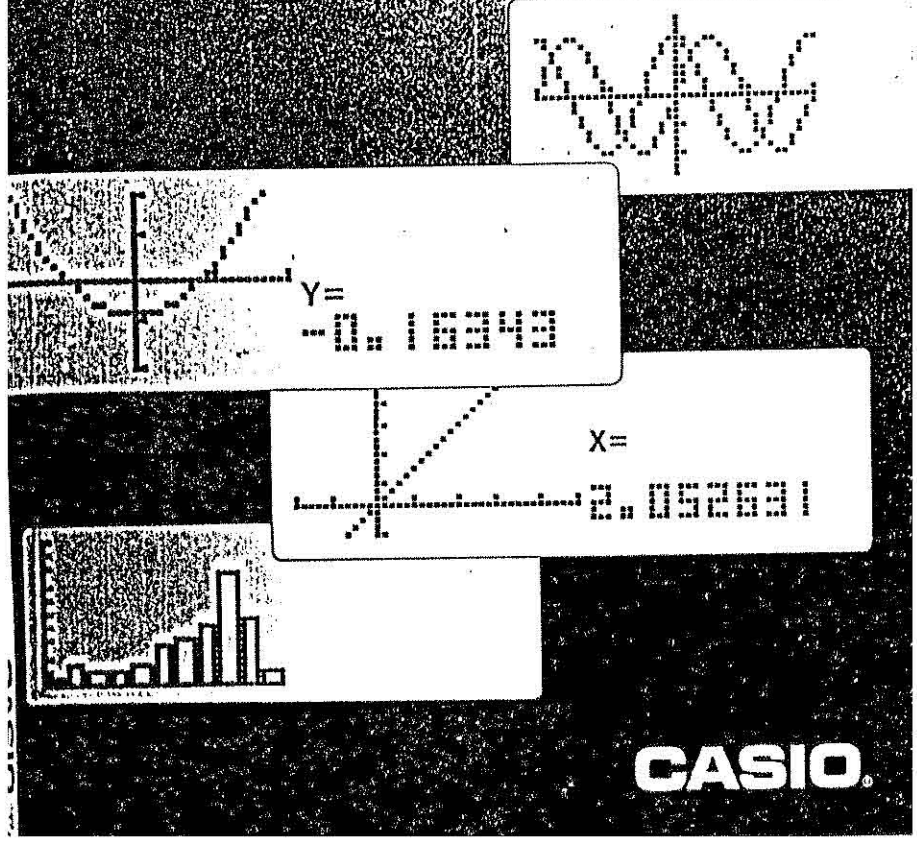
GRAPHIC SCIENTIFIC

fx-6200G

Owner's manual

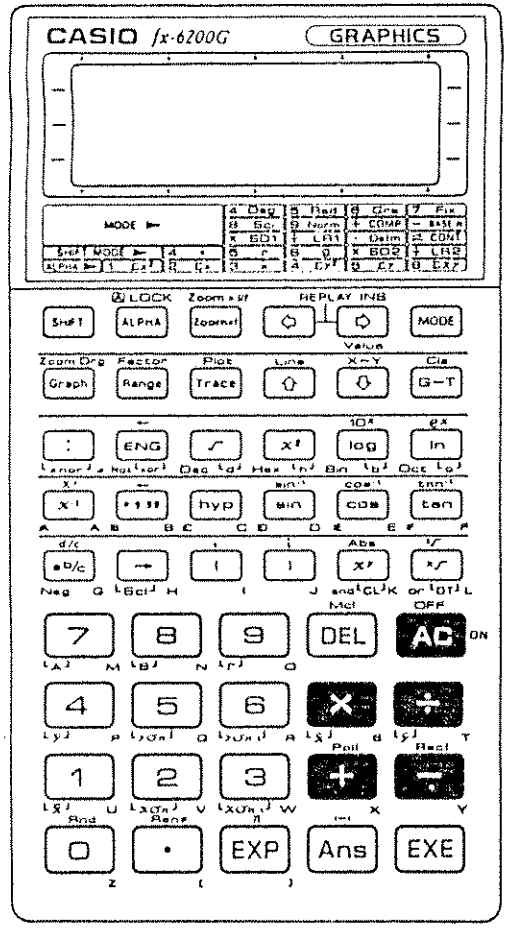


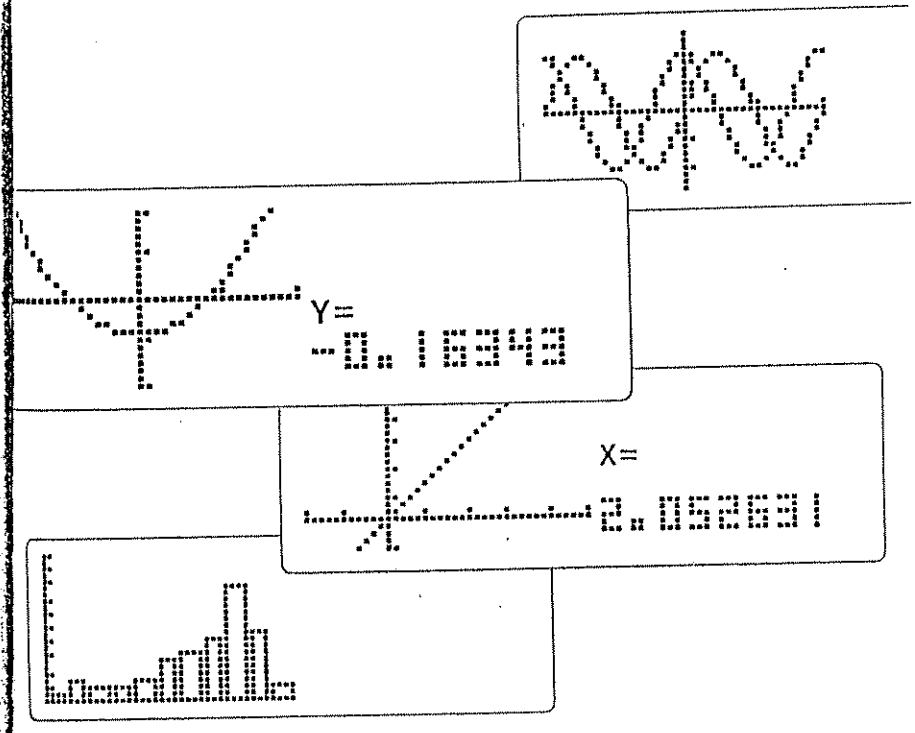
CASIO

SPARE PARTS MASTER

GRAPHIC SCIENTIFIC

fx-6200G





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- Due to limitations imposed by printing processes, the displays shown in this manual are only approximations and may differ somewhat from actual displays.

Introduction

Thank you for your purchase of the CASIO fx-6200G.
This unit is a totally new type of advanced calculator. Besides versatile scientific functions, graph functions also make it possible to produce a wide variety of useful graphs.
Manual calculations can be easily performed following written formulas (true algebraic logic). A replay function is provided that allows confirmation or correction when key operation errors occur.
All of this power built into a compact configuration that folds up to slip right into your pocket.
To use the fx-6200G to its full potential, be sure to carefully read this manual and keep it handy for future reference.

Important — Reset your calculator before using it for the first time!

See page 9 for details on the reset procedure.

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About the Power Supply

■Replacing batteries

Precautions:

Incorrectly using batteries can cause them to burst or leak, possibly damaging the interior of the unit. Note the following precautions:

- Be sure that the positive ⊕ and negative ⊖ poles of each battery are facing in the proper direction.

- Never mix batteries of different types.
- Never mix old batteries and new ones.
- Never leave dead batteries in the battery compartment.
- Never try to recharge the batteries supplied with the unit.
- Do not expose batteries to direct heat, let them become shorted, or try to take them apart.

Keep batteries out of the reach of small children. If swallowed, consult with a physician immediately.

Power is supplied to this unit by two lithium batteries (CR2032). If the power of the batteries should diminish, the display will weaken and become difficult to read. A weak display even after contrast adjustment (see page 27) may indicate power is too low, so the batteries should be replaced. When making replacements, be sure to replace all two batteries.

- **If batteries are used for longer than 5 years, there is the danger of leakage. Be sure to replace batteries at least once every 5 years even if the unit is not used during that period.*
- **The life of the original batteries supplied with the calculator is calculated from the date of installation at the factory, not from the date of purchase.*
- **Stored data are erased when batteries are replaced. Therefore, it is recommended that data required for later use be recorded on a coding sheet before replacing batteries.*

• To replace the batteries

〈Important〉

- Always make sure that the power of the calculator is switched off before replacing batteries.
- Note that replacing batteries and performing the reset operation erases all data stored in the calculator. Be sure to make written copies of data before performing these operations.
- After replacing batteries, be sure to switch the calculator on and then perform the reset operation.

① After making sure that unit power is switched off, remove the 2 screws that hold the back cover of the calculator in place. Remove the back cover.

② Remove the screws that secure the battery holders in place, and remove the battery holders.

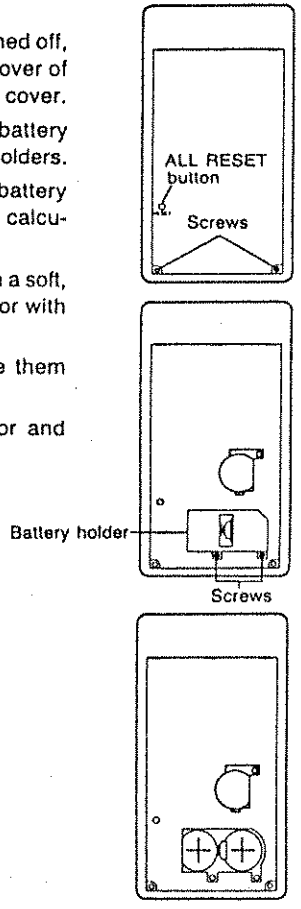
③ Remove the old batteries. If you face the battery compartment down and tap the top of the calculator, the batteries should fall out.

④ Wipe the surfaces of two new batteries with a soft, dry cloth, and load them into the calculator with their positive ⊕ sides facing up.

⑤ Replace the battery holders, and secure them with their screws.

⑥ Replace the back cover of the calculator and secure it in place with its 2 screws.

⑦ Switch power on.



■ Auto Power Off function

The power of the unit is automatically switched off approximately 6 minutes after the last key operation. Once this occurs, power can be restored by pressing the AC key. (Numeric values in the memories or calculation modes are unaffected when power is switched off.)

■ Reset operation

- **Strong external electrostatic charges can cause this calculator to malfunction. Should this happen, perform the following procedure to reset the calculator.**

Warning!

The following procedure clears all data from the memory of the calculator and cannot be undone! To avoid the loss of important data, be sure to always keep written backup copies.

1. Switch the power of the calculator on.
2. Press the RESET button on the back of the calculator with a thin, pointed object. A message appears on the display to confirm whether you want to reset the calculator and clear memory contents.

```
Reset?
```

3. Press EXE to clear the calculator and clear the display. To abort the reset operation without clearing the calculator, press any key other than EXE.

Following the reset procedure described above, the calculator is initialized as follows:

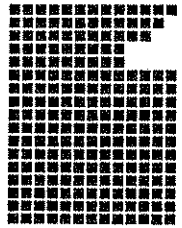
1. COMP mode
2. DEG mode
3. NORM1 mode
4. Decimal mode (for BASE-N calculations)
5. Variable memories cleared
6. Defm 0
7. Answer memory clear
8. Input buffer clear
9. Replay memory clear

- If the Auto Power Off function activates while the "Reset ?" message is displayed, press AC to restore power and then start again from step 1.

Never press the RESET button while internal operations are being performed. Doing so can cause irreparable damage to the memory of your calculator.

Handling Precautions

- Your calculator is made up of precision components. Never try to take it apart.
- Avoid dropping your calculator and subjecting it to other strong impacts.
- Do not store the calculator or leave it in areas exposed to high temperatures or humidity, or large amounts of dust. When exposed to low temperatures, the calculator may require more time to display results and may even fail to operate. Correct operation will resume once the calculator is brought back to normal temperature.
- The display will go blank and keys will not operate during calculations. When you are operating the keyboard, be sure to watch the display to make sure that all your key operations are being performed correctly.
- Replace batteries once every 5 years regardless of how much the calculator is used during that period. Never leave dead batteries in the battery compartment. They can leak and damage the unit.
- Avoid using volatile liquids such as thinner or benzine to clean the unit. Wipe it with a soft, dry cloth, or with a cloth that has been dipped in a solution of water and a neutral detergent and wrung out.
- In no event will the manufacturer and its suppliers be liable to you or any other person for any damages, expenses, lost profits, lost savings or any other damages arising out of loss of data and/or formulas arising out of malfunction, repairs, or battery replacement. The user should prepare physical records of data to protect against such data loss.
- Never dispose of batteries, the liquid crystal panel, or other components by burning them.
- Be sure that the power is off when replacing batteries.
- If the calculator is exposed to a strong electrostatic charge, its memory contents may be damaged or the keys may stop working. In such a case, perform the Reset operation to clear the memory and restore normal key operation.
- Note that strong vibration or impact can cause execution to stop or can damage the calculator's memory contents.
- Before assuming malfunction of the unit, be sure to carefully reread this manual and ensure that the problem is not due to insufficient battery power or operational errors.



General Guide

1-1 Key Markings
1-2 How to Read the Display
1-3 Key Layout
1-4 Key Operations
1-5 Before Beginning Calculations...

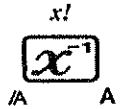
General Guide

Before using this unit for the first time, be sure to perform the Reset operation described on page 9.

Important)
The keys of a scientific calculator perform more than one function. The following explains all of the operations of each key, and so you should read this section carefully before using your calculator for the first time.

1-1 Key Markings

The keys of this unit perform a number of different functions. The key illustrated below, for example, is used to perform 4 different functions: x^{-1}, $x!$, A, ∠A.



Note the following, concerning the key illustrated above.

Mode	Function
Direct Input	x^{-1}
SHIFT	$x!$
ALPHA	A
BASE-N, HEX	∠A

The keys of this calculator can perform a number of different functions. The keyboard is color-coded to help you quickly determine the key sequence you have to perform for each function. The following table shows how to interpret the various key markings on the keyboard.

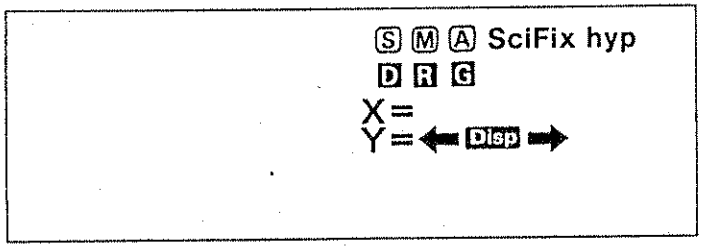
Keyboard Marking	Meaning
Yellow	Press SHIFT and then key.
Red	Press ALPHA and then key.
Green	Press key in BASE-N mode.
In blue brackets	Press key in SD or LR mode.

In addition to the above, there are a number of key sequences indicated on the panel beneath the display (such as [ALPHA ►] [1 Σx^2]). These key sequences can be used in the SD or LR mode only.

1-2 How to Read the Display

■Display indicators

The following indicators appear on the display to show you the current status of the calculator at a glance.



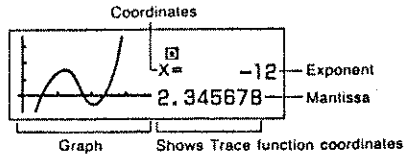
S:	SHIFT key pressed.
M:	MODE key pressed.
A:	ALPHA key pressed.
Sci:	Number of significant digits specified.
Fix:	Number of decimal places specified.
hyp:	hyp key pressed.
D:	Degrees specified at the unit of angular measurement.
R:	Radians specified at the unit of angular measurement.
G:	Grads specified at the unit of angular measurement.
X=, Y=:	Indicates current *x*- and *y*-coordinate location of Trace function pointer.
⬅ ➡:	Indicates display consists of more than 12 characters. "⬅" indicates extra characters run off left side of display, "➡" indicates characters run off right side.
Disp:	Indicates displayed value is intermediate result.

■About the display layout

The display consists of a dot area for graphing, as well as an area for indicators and characters. You can monitor the status of the calculator by viewing the display.

Example

Graph Display



Calculation Display

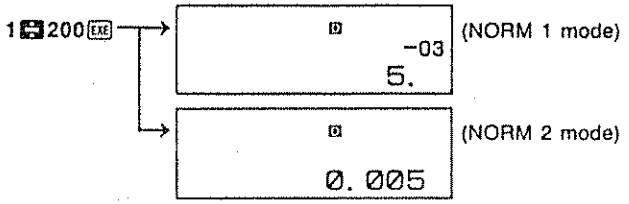
■Exponential display

During normal calculation, this unit is capable of displaying up to 10 digits. Values that exceed this limit, however, are automatically displayed in exponential format. You can choose between 2 different types of exponential display formats.

NORM 1 mode: $10^{-2}(0.01) > |x|, |x| \geqq 10^{10}$

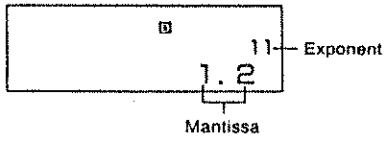
NORM 2 mode: $10^{-9}(0.000000001) > |x|, |x| \geqq 10^{10}$

Selection of these modes can be carried out by pressing [MODE] [9] [EXE], when no specification has been made for the number of decimal places or significant digits. The present status is not displayed, so it is necessary to perform the following procedure to specify either display format:



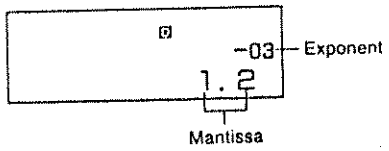
(All of the examples in this manual show calculation results using the NORM 1 mode.)

How to interpret exponential format



➡ 1.2×10^{11} ➡ 120,000,000,000

1.2^{11} indicates that the result is equivalent to 1.2×10^{11}. This means that you should move the decimal point in 1.2 eleven places to the right, since the exponent is positive. This results in the value 120,000,000,000.



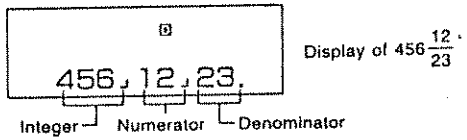
➡ 1.2×10^{-3} ➡ 0.0012

1.2^{-03} indicates that the result is equivalent to 1.2×10^{-3}. This means that you should move the decimal point in 1.2 three places to the left, since the exponent is negative. This results in the value 0.0012.

■Special display formats

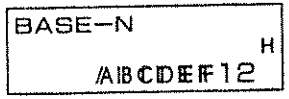
Special display formats are used for the representation of fraction, hexadecimal, and sexagesimal values.

● Fraction value display



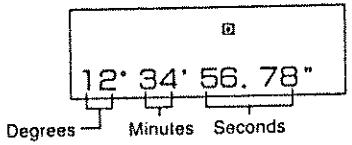
Display of $456\frac{12}{23}$

● Hexadecimal value display



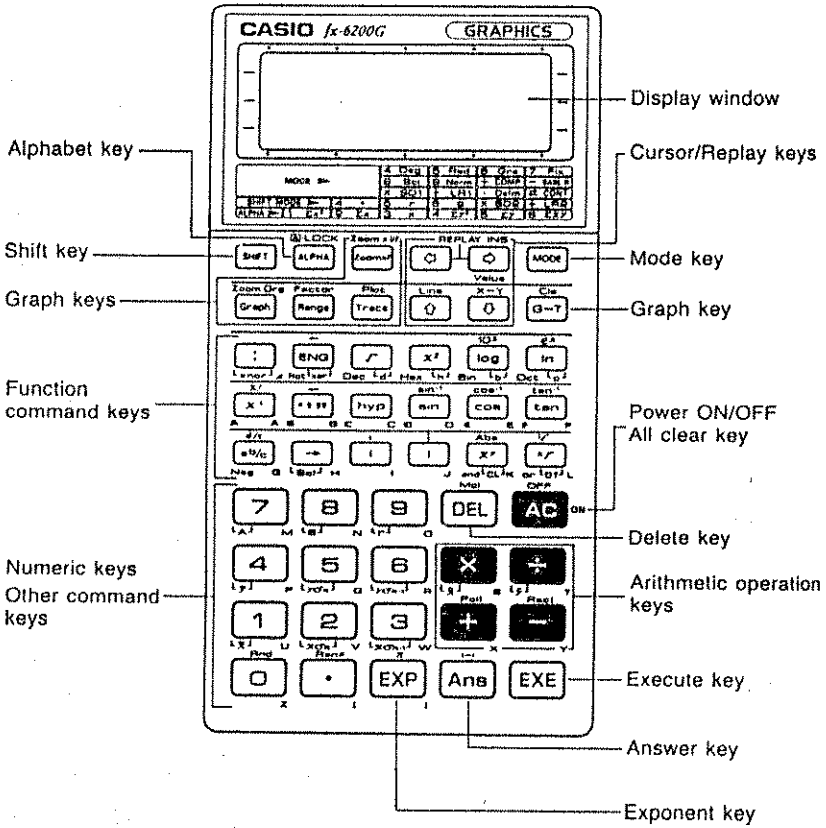
Display of ABCDEF12 (= 1412567278)

● Sexagesimal value display



Display of 12°34'56.78"

1-3 Key Layout



1-4 Key Operations

■Special operation keys

[SHIFT] Shift key

Press when using the function commands and functions marked in yellow on the key panel. An [S] will blink on the display to indicate that [SHIFT] has been pressed. Pressing [SHIFT] again will cause the [S] to disappear from the display and the unit to return to the status it was in before [SHIFT] was originally pressed.

[MODE] Mode key

Use the [MODE] key in combination with [•], [4] through [9], [+], [−], [×], and [÷] to specify the calculation mode and the unit of angular measurement.

- [MODE][4] ... [D] displayed. If [EXE] is pressed, unit of angular measurement is specified as degrees.
- [MODE][5] ... [R] displayed. If [EXE] is pressed, unit of angular measurement is specified as radians.
- [MODE][6] ... [G] displayed. If [EXE] is pressed, unit of angular measurement is specified as grads.
- [MODE][7] ... Fix displayed. Entering a value from 0 to 9 followed by [EXE] will specify the number of decimal places according to the value entered.
  Ex. [MODE][7]3[EXE] → Three decimal places
- [MODE][8] ... Sci displayed. Entering a value from 0 to 9 followed by [EXE] will specify the number of significant digits from 1 to 10.
  Ex. [MODE][8]5[EXE] → 5 significant digits
  [MODE][8]0[EXE] → 10 significant digits
- [MODE][9] ... Pressing [EXE] will cancel the specified number of decimal places or the specified number of significant digits.

**If you have not specified the number of decimal places or the number of significant digits, you can press [MODE][9][EXE] and then change the range of the exponential display. (NORM 1/NORM 2) (See page 16.)*

**With the exception of the BASE-N mode, modes [7] ~ [9] can be used in combination with the manual calculation modes.*

**The mode last selected is retained in memory when the unit's power is switched off.*

- [MODE][•] ... Defm displayed. Entering a value followed by [EXE] will specify the number of memories available.
  Ex. [MODE][•]10[EXE] → Number of memories available increased by 10.

If [EXE] is pressed without entering a value, the current number of memories available will be displayed (see page 37.)

Example [MODE] [·] [EXE]

M-26

[MODE] [+] ... Specifies COMP mode for arithmetic calculation or function calculation.

[MODE] [−] ... For binary, octal or hexadecimal calculations/conversions (BASE-N mode).

[MODE] [×] ... For standard deviation calculations (SD1 mode).

[MODE] [÷] ... For regression calculations (LR1 mode).

[SHIFT] [MODE] [×] ... For production of a bar graph or normal distribution curve according to single variable statistical data (SD2 mode).

[SHIFT] [MODE] [÷] ... For production of a regression line according to paired variable statistical data (LR2 mode).

The x^y and $\sqrt[x]{\ }$ functions are not available in the LR1 mode. To use these functions, first perform the statistical operations and then press [MODE] [+] to enter the COMP mode.

[SHIFT] [MODE] [4] ... Pressed after a numeric value representing degrees (°) is input.

[SHIFT] [MODE] [5] ... Pressed after a numeric value representing radians (r) is input.

[SHIFT] [MODE] [6] ... Pressed after a numeric value representing grads (g) is input.

[ALPHA] Alphabet key

Press to input alphabetic characters or special characters. Pressing [ALPHA] displays [A] and allows the input of only one character. After that, the unit returns to the status it was in before the [ALPHA] key was originally pressed. Pressing [SHIFT] followed by [ALPHA] will lock the unit in this mode and allow consecutive input of alphabetic characters until [ALPHA] is pressed again.

[◢]

[A]	[B]	[C]	[D]	[E]	[F]
[G]	[H]	[I]	[J]	[K]	[L]
[M]	[N]	[O]	[ ]	[ ]
[P]	[Q]	[R]	[S]	[T]
[U]	[V]	[W]	[X]	[Y]
[Z]	[ ]	[ ]	[ ]	[ ]

Cursor/Replay keys

The [◀] key moves the cursor (blinking "_") to the left, [▶] moves the cursor to the right. In the Plot function, the [▲] key moves the pointer up, and [▼] moves the pointer down. Holding any of the keys down will cause the cursor to continuously move in the respective direction.

Once a formula or numeric value is input and [EXE] is pressed, the [◀] key and [▶] key become "replay" keys. In this case, pressing [▶] displays the formula or numeric value from the beginning, while pressing [◀] displays it from the end. This allows the formula to be executed again by changing the values.

Pressing [SHIFT] followed by [INS] displays the insert cursor ([ ]). Entering a value while the insert cursor is displayed inserts the value in the position immediately preceding the insert cursor location.

Pressing [SHIFT] followed by [Line] makes it possible to produce line graphs or regression lines.

After you draw a graph, press [SHIFT] [Value] to display a 7-digit (including the negative sign) value that shows the x-coordinate for the current location of the pointer on the graph. You can switch between display of the x-coordinate and the y-coordinate by pressing [SHIFT] [x⇔y]. Pressing [SHIFT] [Value] changes the coordinate display to 11 digits (including the negative sign) for even more precision.

[DEL] Delete key

Press to delete the character at the current position of the cursor. When the character is deleted, everything to the right of the cursor position will shift one space to the left.

Pressing [SHIFT] [Mcl] [EXE] will clear the memory contents.

[AC] ON All clear/Power ON/Power OFF key

Press to clear all input characters or formulas. You can also use this key to clear the Error message from the display (page 32).

Press to switch the power of the calculator on (even if power was switched off by the Auto Power Off function).

Pressing [SHIFT] [OFF] switches the power of the calculator off. Note that mode setting and memory contents are protected even when power is turned off.

[EXE] Execute key

Press to obtain the result of a calculation or to draw a graph. You can press this key following data input or after a result is obtained to execute the calculation using the previous result.

[Ans] Answer/Minus key

Pressing [Ans] followed by [EXE] will recall the last calculation result. It can be recalled by [Ans][EXE] even after it has been cleared using the [AC] key or by switching the power of the unit off.

Press following [SHIFT] key to entering a numeric value to make that value negative.

Ex. −123 → [SHIFT][(−)]123

■Numeric/Decimal point/Exponent input keys

[0] ~ [9] [•] [EXP]

When entering numeric values, enter the number in order. Press the [•] key to enter the decimal point in the desired position.

To input 1.23×10^{-6}, press 1[•]23[EXP][SHIFT][(−)]6.

[SHIFT] key combinations for the various modes are as follows:

COMP mode ([MODE][+])

[Rnd] [Ran#] [πC]

SD mode ([MODE][×])

[x̄] [xσn] [xσn-1]

[Rnd] [Ran#] [πC]

Standard deviation functions can be used.

LR mode ([MODE][−])

[A] [B] [r]

[ȳ] [yσn] [yσn-1]

[x̄] [xσn] [xσn-1]

[Rnd] [Ran#] [πC]

Paired variable statistic functions can be used.

■Calculation keys

[+] [−] [×] [÷] Arithmetic operation keys

For addition, subtraction, multiplication and division, enter the calculation as it reads. [SHIFT] key combinations for the various modes are as follows:

COMP mode or SD mode

[Pol(][Rec(]... Coordinate transformation

LR mode

[x̂][ŷ]... Estimated value calculation of x and y

[Pol(][Rec(]... Coordinate transformation

■Graph keys

Used to produce a variety of graphs (see page 72 for details). These keys cannot be used in the BASE-N mode.

[Graph] Graph/Original zoom key

- Press before entering a formula to be used for a graph ("Graph Y=" appears on the display).
- Press to return an enlarged or reduced graph to its original size.

[Range] Range/Factor key

- Used to confirm or set the range and size of graphs.
- Press following [SHIFT] to magnify or reduce the upper and lower ranges of graphs.

[Trace] Trace/Plot key

- Used to trace over an existing graph and display the x or y coordinate value.
- Press following [SHIFT] to plot a point on the graph screen.

[Zoom×f] Zoom key

- Press to enlarge the currently shown display in accordance with the factor setting.
- Following [SHIFT], this key causes the graph currently shown on the display to be reduced in accordance with the factor setting.

Graph-text/Clear screen key

- Switches between the graph display and text display (see page 33).
- SHIFT Cls EXE clears the graph display ("done" is displayed).

■Function keys

Press for functional calculation. Various uses are available in combination with the SHIFT key, and/or depending on the mode being used.

Multistatement key

- Press to separate formulas or commands in consecutive calculations. The result of such combinations is known as a multistatement (see page 53).
- Press following SHIFT in the BASE-N mode to enter the logical operation for negation of logical sums (xnor).
- When pressed following the ALPHA key, the results of each section of the consecutive calculations are sequentially displayed with each press of EXE.

Engineering/Negation key

- Press to convert a calculation result to an exponential display whose exponent is a multiple of three.

(10^{3} = kilo k, 10^{6} = mega M, 10^{9} = giga G, 10^{-3} = milli m, 10^{-6} = micro μ, 10^{-9} = nano n, 10^{-12} = pico p)

- When obtaining logical negation for a value in the BASE-N mode, press prior to entering the value.
- Press following the SHIFT key in the BASE-N mode to obtain the exclusive logical sum.

Square root key

- Press prior to entering a numeric value to obtain the square root of that value.
- Press followed by EXE in the BASE-N mode to specify the decimal calculation mode.
- When pressed following the SHIFT key in the BASE-N mode, the subsequently entered value is specified as a decimal value.

Square key

- Press after a numeric value is entered to obtain the square of that value.
- Press followed by EXE in the BASE-N mode to specify the hexadecimal calculation mode.
- When pressed following the SHIFT key in the BASE-N mode, the subsequently entered value is specified as a hexadecimal value.

Common logarithm/Antilogarithm key

- Press prior to entering a value to obtain the common logarithm of that value.
- When pressed following the SHIFT key, the subsequently entered value becomes an exponent of 10.
- Press followed by EXE in the BASE-N mode to specify the binary calculation mode.
- When pressed following the SHIFT key in the BASE-N mode, the subsequently entered value is specified as a binary value.

Natural logarithm/Exponential key

- Press prior to entering a value to obtain the natural logarithm of that value.
- When pressed following the SHIFT key, the subsequently entered value becomes an exponent of *e*.
- Press followed by EXE in the BASE-N mode to specify the octal calculation mode.
- When pressed following the SHIFT key in the BASE-N mode, the subsequently entered value is specified as an octal value.

Reciprocal/Factorial key

- Press after entering a value to obtain the reciprocal of that value.
- When pressed following the SHIFT key, the factorial of a previously entered value can be obtained.
- Press in the BASE-N mode to enter A (10_{10}) of a hexadecimal value.

Degree/minute/second key (decimal↔sexagesimal key)

- Press to enter sexagesimal value (degree/minute/second or hour/minute/second).
  Ex. 78°45'12"→78 ° ' " 45 ° ' " 12 ° ' "
- When pressed following the SHIFT key, a decimal based value can be displayed in degrees/minutes/seconds (hours/minutes/seconds).
- Press in the BASE-N mode to enter B (11_{10}) of a hexadecimal value.

hyp Hyperbolic key

- Pressing hyp, and then sin, cos, or tan prior to entering a value produces the respective hyperbolic function (sinh, cosh, tanh) for the value.
- Pressing SHIFT, then hyp and then sin, cos or tan prior to entering a value produces the respective inverse hyperbolic function ($\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$) for the value.
- Press in the BASE-N mode to enter C (12_{10}) of a hexadecimal value.

sin, cos, tan Trigonometric function/Inverse trigonometric function keys

- Press one of these keys prior to entering a value to obtain the respective trigonometric function for the value.
- Press SHIFT and then one of these keys prior to entering a value to obtain the respective inverse trigonometric function for the value.
- Press in the BASE-N mode to enter D, E, F (13_{10}, 14_{10}, 15_{10}) of a hexadecimal value.

a b/c Fraction/Negative key

- Use this key for input of simple fractions and mixed fractions.

  Ex. To input 23/45: 23 a b/c 45

  To input 2-3/4: 2 a b/c 3 a b/c 4
- For improper fractions, press this key following SHIFT (indicated by SHIFT d/c in this manual).
- Press in the BASE-N mode prior to entering a value to obtain the negative of that value. The negative number is the two's complement of the value entered.

→ Assignment key

- Press prior to entering a memory to assign the result of a calculation to that memory.

  Ex. To assign the result of 12 + 45 to memory A: 12 + 45 → ALPHA A EXE
- Press this key following SHIFT to clear all data from the statistical memories.

( ) Parenthesis keys

- Press the open parenthesis key and the closed parenthesis key at the position required in a formula.
- When pressed following the SHIFT key, a comma or semicolon can be inserted to separate the arguments in coordinate transformation or consecutive calculations.

x^y Power/Absolute value key

- Enter x (any number), press this key and then enter y (any number) to compute x to the power of y. In the SD or LR mode, this function is only available after pressing the SHIFT key.
- Press following the SHIFT key to obtain the absolute value of a subsequently entered numeric value.
- Press in the BASE-N mode to obtain a logical product ("and").
- Press in the SD or LR mode to delete input data.

$\sqrt{\ }$ Root/Cube root key

- Enter x, press this key and then enter y to calculate the xth root of y. In the SD or LR mode, this function is only available after pressing the SHIFT key.
- Press following the SHIFT key to obtain the cube root of a subsequently entered numeric value.
- Press in the BASE-N mode to obtain a logical sum ("or").
- Used as a data input key in the SD or LR mode.

■Contrast adjustment

Pressing the ◁ or ▷ key following the MODE key adjusts the contrast of the display. Pressing ◁ makes the screen lighter, while ▷ makes it darker. Holding either key down will cause the display to successively become respectively lighter or darker.

Pressing any other key besides MODE, ◁, or ▷ (as well as △, ▽) cancels contrast adjustment.

**If the display becomes dim and difficult to read, even if you increase contrast, it probably means that battery power is getting low. In such a case, replace batteries as soon as possible. After replacing batteries, perform the RESET operation described on page 9.*

**Contrast adjustment is impossible during range display using the Range key or during factor display using the Factor key (see page 74, 80).*

1-5 Before Beginning Calculations....

■Calculation priority sequence

This calculator employs true algebraic logic to calculate the parts of a formula in the following order:

① Coordinate transformation
Pol (x, y), Rec (r, θ)

② Type A functions
With these functions, the value is entered and then the function key is pressed.
x^2, x^{-1}, $x!$, °, ʳ, ᵍ, °′ ″

③ Power/root
x^y, $\sqrt[x]{\ }$

④ Fractions
$a\,b/c$

⑤ Abbreviated multiplication format in front of π, memory or parenthesis
2π, 4R, etc.

⑥ Type B functions
With these functions, the function key is pressed and then the value is entered.
$\sqrt{\ }$, $\sqrt[3]{\ }$, log, ln, e^x, 10^x, sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, (−), Abs, parenthesis, (following in BASE-N calculations only) d, h, b, o, Neg, Not

⑦ Abbreviated multiplication format in front of Type B functions
$2\sqrt{3}$, A log2, etc.

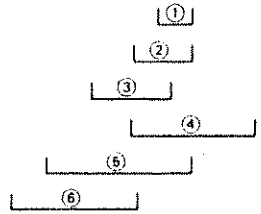
⑧ ×, ÷

⑨ +, −

⑩ and
⑪ or, xor, xnor
] BASE-N calculations only.

When functions with the same priority are used in series, execution is performed from right to left.
$e^x\ln\sqrt{120} \rightarrow e^x[\ln(\sqrt{120})]$
Otherwise, execution is from left to right.
Compound functions are executed from right to left.
Anything contained within parentheses receives highest priority.

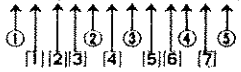
Example 2 + 3 × (log sin2π² + 6.8) = 22.07101691 (in the "Rad" mode)



■Number of stacks

This calculator uses a memory known as a "stack" for temporary storage of low priority numeric values and commands (functions, etc.). The numeric value stack has 10 levels, while the command stack has 24. If a formula exceeds the stack space available, a stack error (Stk ERROR) message appears on the display.

Example 2 × ((3 + 4 × (5 + 4) + 3) + 5) + 8 =



Numeric stack value

①	2
②	3
③	4
④	5
⑤	4
⋮	

Command stack

[1]	×
[2]	(
[3]	(
[4]	+
[5]	×
[6]	(
[7]	+
⋮	

Calculations are performed in sequence, with the highest priority operation first. Once a calculation is executed, it is cleared from the stack.

■Calculation modes

This unit features modes for manual calculations, and modes for general as well as statistical calculations. The proper mode to suit calculational requirements should be employed.

There are a total of six calculation modes which are employed according to the type of calculation.

1. **COMP mode**
   General calculations, including functional calculations.
2. **BASE-N mode**
   Binary, octal, decimal, hexadecimal conversion and calculations, as well as logical operations. (See page 58.) Function calculations and graph drawing cannot be performed.
3. **SD1 mode**
   Standard deviation calculation (single-variable statistics). (See page 63.)
4. **SD2 mode**
   For production of bar graph or normal distribution curve according to single-variable statistical data. (See page 93.)
5. **LR1 mode**
   Regression calculation (paired-variable statistics). (See page 65.)
6. **LR2 mode**
   For production of regression line graph according to paired-variable statistical data. (See page 96.)

With so many modes available, calculations should always be performed after confirming which mode is active.

**IMPORTANT: When the power of the unit is switched off (including Auto Power Off), the current system mode is cancelled. However, the calculation mode, number of decimal place setting ([MODE][7]n), number of significant digits ([MODE][8]n), and angle unit (Deg, Rad, Gra) will be retained in memory.*

**To return to standard operation (initialized state) press [MODE][▶] (COMP mode) — [MODE][9] (Norm mode).*

■Number of input/output digits and calculation digits

•The allowable input/output range (number of digits) of this unit is 10 digits for a mantissa and 2 digits for an exponent. Calculations, however, are internally performed with a range of 12 digits for a mantissa and 2 digits for an exponent.

Example $3 \times 10^5 \div 7 =$

[3][EXP][5][÷][7][EXE]
[3][EXP][5][÷][7][▶][4][2][8][5][7][EXE]

```
42857.14286
0.1428571
```

**Calculation results greater than 10^{10} (10 billion) or less than 10^{-2} (0.01) are automatically displayed in exponential form.*

Example $123456789 \times 9638 =$

[1][2][3][4][5][6][7][8][9]
[×][9][6][3][8][EXE]

```
                12  Exponent
1.189876532         Mantissa
```

Once a calculation is completed, the mantissa is rounded off to 10 digits and displayed. And the displayed mantissa can be used for the next calculation.

Example $3 \times 10^5 \div 7 =$

[3][EXP][5][÷][7][EXE]
[▶][4][2][8][5][7][EXE]

```
42857.14286
0.14286
```

**Values are stored in memory with 12 digits for the mantissa and 2 digits for the exponent.*

■Overflow and errors

If the calculation range of the unit is exceeded, or incorrect inputs are made, an error message will appear on the display window and subsequent operation will be impossible. This is the error check function. The following operations will result in errors:

(1) The answer, whether intermediate or final, or any value in memory exceeds the value of $\pm 9.999999999 \times 10^{99}$.
(2) An attempt is made to perform functional calculations that exceed the input range. (See page 106.)
(3) Improper operation during statistical calculations.
(Ex. Attempting to obtain $\bar{x}$ or $x\sigma_n$ without data input.)
(4) The capacity of the numeric value stack or the command stack is exceeded.
(Ex. Entering 23 successive (-)'s followed by 2+3×4[EXE])
(5) Even though memory has not been expanded, a memory name such as Z [2] is used. (See page 37 for details on memory.)
(6) Input errors are made.
(Ex. 5××3[EXE])
(7) When improper arguments are used in commands or functions that require arguments. (i.e. Input of an argument outside of the range of 0 ~ 9 for Sci or Fix.)

The following error messages will be displayed for the operations noted above:

(1) ~ (3) Ma ERROR (Mathematical error)
(4) Stk ERROR (Stack error)
(5) Mem ERROR (Memory error)
(6) Syn ERROR (Syntax error)
(7) Arg ERROR (Argument error)

Further operation will become impossible when an error message is displayed. Press [AC], [←], or [→] to cancel the error.
Pressing [AC] cancels the error and new key input becomes possible.
See the Error Message Table on page 105.

■Number of input characters

This unit features a 127-step area for calculation execution.
One function comprises one step. Each press of numeric or [+], [−], [×] and [÷] keys comprise one step. Though such operations as [SHIFT][√] require two key operations, they actually comprise only one function and, therefore, only one step. These steps can be confirmed using the cursor. With each press of the [←] or [→] key the cursor is moved one step.
Input characters are limited to 127-steps. Usually the cursor is represented by a blinking "_", but once the 121st step is reached the cursor changes to a blinking "■". If the "■" appears during a calculation, the calculation should be divided at some point and performed in two parts.

**When numeric values or calculation commands are input, they appear on the display window from the left. Calculational results, however, are displayed from the right.*

■Graphic and text displays

This unit has a graph display for production of graphs, as well as a text display for production of formulas and commands. These two types of display contents are stored independently of each other.
Switching between graph and text displays is performed using the [G↔T] key. Each press of [G↔T] switches from the current type of display to the other.

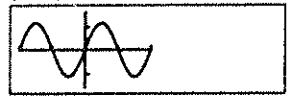
Example

[Graph][sin][ALPHA][X]

(Text display)

[EXE]

(Graphic display)



[G↔T]

(Text display)

[G↔T]

(Graphic display)

Operations to clear the display depend upon the type of display being shown:
Graphs: [SHIFT][CLS][EXE]
Text: [AC]
Pressing the [AC] key causes a cleared text display to appear if pressed during a graph display.

■ Corrections

•To make corrections in a formula that is being input, use the ◁ and ▷ keys to move to the position of the error and press the correct keys.

Example **To change an input of 122 to 123:**

Keys	Display
1 2 2	122_
◁	12̲2
3	123_

Example **To change an input of cos60 to sin60:**

Keys	Display
cos 6 0	cos 60_
◁ ◁ ◁	co̲s 60
sin	sin 6̲0

**If, after making corrections, input of the formula is complete, the answer can be obtained by pressing EXE. If, however, more is to be added to the formula, advance the cursor using the ▷ key to the end of the formula for input.*

•If an unnecessary character has been included in a formula, use the ◁ and ▷ keys to move to the position of the error and press the DEL key. Each press of DEL will delete one command (one step).

Example **To correct an input of 369 × × 2 to 369 × 2:**

Keys	Display
3 6 9 × × 2	369××2_
◁ ◁ DEL	369×2̲

•If a character has been omitted from a formula, use the ◁ and ▷ keys to move to the position where the character should have been input, and press SHIFT followed by the INS key. Press SHIFT INS and insertions can be subsequently performed as desired.

Example **To correct an input of 2.36^2 to $\sin 2.36^2$:**

Keys	Display
2 • 3 6 x^2	2. 36²_
◁ ◁ ◁ ◁ ◁	2̲. 36²
SHIFT INS	⌈2⌋. 36²
sin	sin ⌈2⌋. 36²

**When SHIFT INS are pressed, the letter at the insertion position is surrounded by "⌈⌋" and blinks. The insert function is activated until you press ◁, ▷, or AC, or until you perform SHIFT INS again.*

■ Memory

This unit contains 26 standard memories. Memory names are composed of the 26 letters of the alphabet. Numeric values with 12 digits for a mantissa and 2 digits for an exponent can be stored.

Example **To store 123.45 in memory A:**

Keys	Display
1 2 3 • 4 5 → ALPHA A	123. 45→A_
EXE	123. 45

Values are assigned to a memory using the → key followed by the memory name.

Example **To store the sum of memory A + 78.9 in memory B:**

Keys	Display
ALPHA A + 7 8 • 9 → ALPHA B	A+78. 9→B_
EXE	202. 35

Example **To add 74.12 to memory B:**

Keys	Display
ALPHA B + 7 4 • 1 2 → ALPHA B	B+74. 12→B_
EXE	276. 47

•To check the contents of a memory, press the name of the memory to be checked followed by [EXE].

[ALPHA] [A] [EXE]

```
123. 45
```

•To clear the contents of a memory (make them 0), proceed as follows:

Example **To clear the contents of memory A only:**

[0] [→] [ALPHA] [A] [EXE]

```
0.
```

Example **To clear the contents of all the memories:**

[SHIFT] [Mcl]
[EXE]

```
Mcl_
0.
```


■Memory expansion

Memory is expanded in units of one. A maximum of 50 memories can be added for a maximum total of 76 (26 + 50). Expansion is performed by pressing [MODE], followed by [·], a value representing the size of the expansion, and then [EXE].

Example **To expand the number of memories by 30 to bring the total to 56:**

[MODE] [·] [3] [0]

```
Defm 30_
```

[EXE]

```
M-56
```

Number of memories

The number of memories is displayed. To check the current number of memories, press [MODE], followed by [·] and then [EXE].

[MODE] [·] [EXE]

```
M-56
```

To initialize the number of memories (to return the number to 26), enter a zero for the value in the memory expansion sequence outlined above.

[MODE] [·] [0] [EXE]

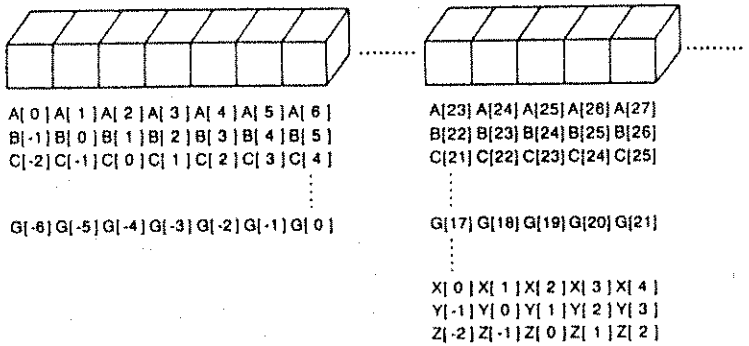
```
M-26
```

• Using expanded memories

Expanded memories are used in the same manner as standard memories, and are referred to as Z[1], Z[2], etc. The letter Z followed by a value in brackets indicating the sequential position of the memory is used as the memory name. (Brackets are formed by [ALPHA] [·] for "[" and [ALPHA] [EXP] for "]".) After the number of memories has been expanded by 5, memories Z[1] through Z[5] are available. The use of these memories is similar to that of a standard computer array, with a subscript being appended to the name.

■Cautions when using array-type memories

When using array-type memories, a subscript is appended to an alphabetic character that represents a standard memory from A through Z.
Therefore, care must be taken to prevent overlap of memories.
The relation is as follows:



Manual Calculations

2-1 Basic Calculations
2-2 Special Functions
2-3 Functional Calculations
2-4 Binary, Octal, Decimal, Hexadecimal Calculations
2-5 Statistical Calculations

2-1 Basic Calculations

■ Arithmetic operations

- Arithmetic operations are performed by pressing the keys in the same sequence as in the formula.
- For negative values, press [SHIFT] [(−)] before entering the value.

Example	Operation	Display
$23 + 4.5 - 53 = -25.5$	23 [+] 4.5 [−] 53 [EXE]	−25.5
$56 \times (-12) + (-2.5) = 268.8$	56 [×] [SHIFT] [(−)] 12 [+] [SHIFT] [(−)] 2.5 [EXE]	268.8
$12369 \times 7532 \times 74103 = 6.903680613 \times 10^{12}$ (6903680613000)	12369 [×] 7532 [×] 74103 [EXE]	12 6.903680613
*Results greater than 10^{10} (10 billion) or less than 10^{-2} (0.01) are displayed in exponential form.		
$(4.5 \times 10^{75}) \times (-2.3 \times 10^{-79}) = -1.035 \times 10^{-3}$ (−0.001035)	4.5 [EXP] 75 [×] [SHIFT] [(−)] 2.3 [EXP] [SHIFT] [(−)] 79 [EXE]	−03 −1.035 (NORM 1)
$(2+3) \times 10^2 = 500$	[(] 2 [+] 3 [)] [×] 1 [EXP] 2 [EXE]	500.
*The correct result cannot be derived by entering [(] 2 [+] 3 [)] [EXP] 2. Be sure to enter [×] 1 between the [)] and [EXP] in the above example.		
$(1 \times 10^5) \div 7 = 14285.71429$	1 [EXP] 5 [÷] 7 [EXE]	14285.71429
$(1 \times 10^5) \div 7 - 14285 = 0.7142857$	1 [EXP] 5 [÷] 7 [−] 14285 [EXE]	0.7142857
*Internal calculations are calculated with 12 digits for a mantissa, and the result is displayed rounded off to 10 digits. Internally, however, the mantissa of the result is 12 digits.		

- For mixed arithmetic operations, multiplication and division are given priority over addition and subtraction.

Example	Operation	Display
$3 + 5 \times 6 = 33$	3 [+] 5 [×] 6 [EXE]	33.
$7 \times 8 - 4 \times 5 = 36$	7 [×] 8 [−] 4 [×] 5 [EXE]	36.
$1 + 2 - 3 \times 4 \div 5 + 6 = 6.6$	1 [+] 2 [−] 3 [×] 4 [÷] 5 [+] 6 [EXE]	6.6

■ Parenthesis calculations

Example	Operation	Display
$100 - (2+3) \times 4 = 80$	100 [−] [(] 2 [+] 3 [)] [×] 4 [EXE]	80.
$2 + 3 \times (4+5) = 29$	2 [+] 3 [×] [(] 4 [+] 5 [EXE]	29.
*Closed parentheses occurring immediately before operation of the [EXE] key may be omitted, no matter how many are required.		
$(7-2) \times (8+5) = 65$	[(] 7 [−] 2 [)] [(] 8 [+] 5 [EXE]	65.
*A multiplication sign [×] occurring immediately before an open parenthesis can be omitted.		
$10 - \{2 + 7 \times (3+6)\} = -55$	10 [−] [(] 2 [+] 7 [(] 3 [+] 6 [EXE]	−55.
*Henceforth, abbreviated style will not be used in this manual.		
$\frac{2\times3+4}{5} = (2\times3+4) \div 5 = 2$	[(] 2 [×] 3 [+] 4 [)] [÷] 5 [EXE]	2.
$\frac{5\times6+6\times8}{15\times4+12\times3} = 0.8125$	[(] 5 [×] 6 [+] 6 [×] 8 [)] [÷] [(] 15 [×] 4 [+] 12 [×] 3 [)] [EXE]	0.8125
$(1.2 \times 10^{19}) - \{(2.5 \times 10^{20}) \times \frac{3}{100}\} = 4.5 \times 10^{18}$	1.2 [EXP] 19 [−] [(] 2.5 [EXP] 20 [×] 3 [÷] 100 [)] [EXE]	18 4.5
$\frac{6}{4\times5} = 0.3$	6 [÷] [(] 4 [×] 5 [)] [EXE]	0.3
*The above is the same as 6 [÷] 4 [÷] 5 [EXE].		

■Memory calculations

- The contents of memories are not erased when power is off. They are cleared by pressing [SHIFT] followed by [Mcl] and then [EXE].

Example	Operation	Display
	9.874 [⊟] [ALPHA] [A] [EXE]	9.874
9.874 × 7 = 69.118	[ALPHA] [A] [×] 7 [EXE]	69.118
9.874 × 12 = 118.488	[ALPHA] [A] [×] 12 [EXE]	118.488
9.874 × 26 = 256.724	[ALPHA] [A] [×] 26 [EXE]	256.724
9.874 × 29 = 286.346	[ALPHA] [A] [×] 29 [EXE]	286.346

*The [⊟] key is used to input numeric values in memory. (Clearing a memory before input is not required, because the previous value in the memory will be automatically replaced with the new value.)

23 + 9 = 32	23 [+] 9 [⊟] [ALPHA] [B] [EXE]	32.
53 − 6 = 47	53 [−] 6 [EXE]	47.
−) 45 × 2 = 90	[ALPHA] [B] [+] [Ans] [⊟] [ALPHA] [B] [EXE]	79.
99 ÷ 3 = 33	45 [×] 2 [EXE]	90.
Total 22	[ALPHA] [B] [−] [Ans] [⊟] [ALPHA] [B] [EXE]	−11.
	99 [÷] 3 [EXE]	33.
	[ALPHA] [B] [+] [Ans] [⊟] [ALPHA] [B] [EXE]	22.
12 × (2.3 + 3.4) − 5 = 63.4	2.3 [+] 3.4 [⊟] [ALPHA] [G] [EXE]	5.7
	12 [×] [ALPHA] [G] [−] 5 [EXE]	63.4
30 × (2.3 + 3.4 + 4.5) − 15	4.5 [⊟] [ALPHA] [H] [EXE]	4.5
× 4.5 = 238.5	30 [×] [(] [ALPHA] [G] [+] [ALPHA] [H] [)]	
	[−] 15 [ALPHA] [H] [EXE]	238.5

*Multiplication signs (×) immediately before memory names can be omitted.

■Specifying the number of decimal places, the number of significant digits and the exponent display

- To specify the number of decimal places, press [MODE] followed by [7], a value indicating the number of places (0—9) and then [EXE].
- To specify the number of significant digits, press [MODE] followed by [8], a value indicating the number of significant digits (0—9 to set from 1 to 10 digits) and then [EXE].
- Pressing the [ENG] key or [SHIFT] followed by [ENG] will cause the exponent display for the number being displayed to change in multiples of 3.
- The specified number of decimal places or number of significant digits will not be cancelled until another value or [MODE] [9] is specified using the sequence: [MODE], [9], [EXE]. (Specified values are not cancelled even if power is switched off or another mode (besides [MODE] [9]) is specified.)
- Even if the number of decimal places and number of significant digits are specified, internal calculations are performed in 12 digits for a mantissa, and the displayed value is stored in 10 digits. To convert these values to the specified number of decimal places and significant digits, press [SHIFT] followed by [Rnd] and then [EXE].

You cannot specify the display format (Fix, Sci) while the calculator is in the BASE-N mode. Such specifications can only be made if you first exit the BASE-N mode.

Example	Operation	Display
100 ÷ 6 = 16.66666666...	100 [÷] 6 [EXE]	16.66666667
	(Four decimal places specified.) [MODE] [7] 4 [EXE]	Fix 16.6667
	(Specification cancelled.) [MODE] [9] [EXE]	16.66666667
	(Five significant digits specified.) [MODE] [8] 5 [EXE]	Sci 01 1.6667
	(Specification cancelled.) [MODE] [9] [EXE]	16.66666667
	*Values are displayed rounded off to the place specified.	
200 ÷ 7 × 14 = 400	(Three decimal places specified.) [MODE] [7] 3 [EXE]	16.667
	(Continues calculation with 10 digits display.) 200 [÷] 7 [EXE]	Fix 28.571
	[×]	← Fix 8.57142857 × _
	14 [EXE]	Fix 400.000

Example	Operation	Display
If the same calculation is performed with the specified number of digits:		
	200 ÷ 7 EXE	Fix 28.571
(Value stored internally cut off at specified decimal place.)		
	SHIFT Rnd EXE	Fix 28.571
	×	Fix 28.571 × _
	14 EXE	Fix 399.994
	(Specification cancelled.) MODE 9 EXE	399.994
123m × 456 = 56088m	123 × 456 EXE	56088.
= 56.088km	ENG	03 56.088
78g × 0.96 = 74.88g	78 × 0.96 EXE	74.88
= 0.07488kg	SHIFT ENG	03 0.07488

2-2 Special Functions

■Answer function

The Answer function stores the result of the most recent calculation. Once a numeric value or numeric expression is entered and EXE is pressed, the result is stored by this function.
To recall the stored value, press the Ans key. When Ans is pressed, "Ans" appears on the display along with the Answer function value. The value can be used in subsequent calculations.
**Since the "Ans" function works just like any other memory, it will be referred to as "Ans memory" throughout this manual.*

Example 123 + 456 = 579
789 − 579 = 210

AC 1 2 3 + 4 5 6 EXE	579.
7 8 9 − Ans	789−Ans_
EXE	210.

Numeric values with 12 digits for a mantissa and 2 digits for an exponent can be stored in the Ans memory. The Ans memory is not cleared even if the power of the unit is turned off. Each time EXE is pressed, the value in the Ans memory is replaced with the value produced by the new calculation. When execution of a calculation results in an error, however, the Ans memory retains its current value.

When a value is stored to another memory using the EXE key, that value is not stored in the Ans memory.

Example **Perform calculation 78 + 56 = 134, then store the value 123 to memory A:**

AC 7 8 + 5 6 EXE	134.
Ans EXE ... Checking the content of Ans memory.	134.
1 2 3 → ALPHA A EXE	123.
Ans EXE	134.

The Ans memory can be used in the same manner as the other memories, thus making it possible to use it in calculation formulas. In multiplication operations, the [×] immediately before [Ans] can be omitted.

Example $15 \times 3 = \underline{45}$
$78 \times \underline{45} - 23 = 3487$

AC 1 5 × 3 EXE	45.
7 8 Ans − 2 3 EXE	3487.

■Continuous calculation function

Even if calculations are concluded with the [EXE] key, the result obtained can be used for further calculations. Such calculations are performed with 10-digit mantissa of the displayed value.

Example **To calculate $\div 3.14$ after $3 \times 4 = 12$:**

AC 3 × 4 EXE	12.
(Continuing) ÷ 3 · 1 4	12. ÷3. 14_
EXE	3. 821656051

Example **To calculate $1 \div 3 \times 3 =$:**

AC 1 ÷ 3 × 3 EXE	1.
1 ÷ 3 EXE	0. 3333333333
(Continuing) × 3 EXE	0. 9999999999

This function can be used with memory and Type A functions (x^2, x^{-1}, $x!$, °, ′, ″, see page 28), +, −, x^y and $\sqrt[x]{}$.

Example **To store the result of 12×45 in memory C:**

AC 1 2 × 4 5 EXE	540.
(Continuing) → ALPHA C	540. →C_
EXE	540.

Example **To square the result of $78 \div 6 = 13$:**

AC 7 8 ÷ 6 EXE	13.
(Continuing) x^2	13. ²_
EXE	169.

■Replay function

This function stores the latest formula executed. After execution is complete, pressing either the [⇨] or [⇦] key will display the formula.
Pressing [⇨] will display the formula from the beginning, with the cursor located under the first character. Pressing [⇦] will display the formula from the end, with the cursor located at the space following the last character. After this, use [⇨] and [⇦] to move the cursor, to check the formula. You can edit numeric values or commands for subsequent execution.

Example

AC 1 2 3 × 4 5 6 EXE	56088.
⇨	123×456

**The formula appears after clearing the display.*

EXE	56088.
⇦	123×456_

*As with the number of input steps (see page 32), the replay function can accept input of up to 127 steps.

*The replay function is not cleared even when [AC] is pressed or when power is turned off, so contents can be recalled even after [AC] is pressed.

Example

[AC] [1] [2] [3] [×] [4] [5] [6]	123×456_
[EXE]	56088.
[AC]	_
[←]	123×456_

*Replay function is cleared when mode or operation is switched.

■Error position display function

When an ERROR message appears, press [←] or [→] to display the calculation with the cursor located at the step that caused the error. You can also clear an error by pressing [AC] and then reenter the values and formulas from the beginning.

Example **14 ÷ 0 × 2.3 mistakenly input instead of 14 ÷ 10 × 2.3:**

[AC] [1] [4] [÷] [0] [×] [2] [•] [3] [EXE]	Ma ERROR
[→] (or [←])	14÷0×2. 3

Cursor indicates where error is generated

[←] [SHIFT] [INS] [1]	14÷10×2. 3
[EXE]	3. 22

■Multistatement function

- With the multistatement function, multiple statements are linked together with a colon ([:]) separating them.
- Pressing the [EXE] key after a multistatement is entered causes the entire chain of statements to be executed from left to right.
- Using "◢" ([ALPHA] [◢]) in place of a colon displays the calculation result up to the point that "◢" is encountered.

Example $6.9 \times \underline{123} = 848.7$
$\underline{123} \div 3.2 = 38.4375$

[1] [2] [3] [−] [ALPHA] [A] [:] [6] [•] [9] [×] [ALPHA] [A] [ALPHA] [◢] [ALPHA] [A] [÷] [3] [•] [2]	6. 9×A◢A÷3. 2_
[EXE]	848. 7

Appears on display when "◢" is used.

[EXE]	38. 4375

*The final result of a multistatement is always displayed, regardless of whether a "◢" symbol is input at the end of the last statement in the chain.

*Consecutive calculations contained in multistatements cannot be performed.

123 × 456 : × 5
└ Invalid

2-3 Functional Calculations

■Angular measurement units

- The unit of angular measurement (degrees, radians, grads) is set by pressing [MODE] followed by a value from 4 through 6 and then [EXE].
- The numeric value from 4 through 6 specifies degrees, radians and grads respectively.
- Once a unit of angular measurement is set, it remains in effect until a new unit is set. Settings are not cleared when power is off.
- You cannot specify the unit of angular measurement (degrees, radians, grads) while the calculator is in the BASE-N mode. Such specifications can only be made if you first exit the BASE-N mode.

Example	Operation	Display
Conversion of 4.25 rad to degrees	[MODE][4][EXE] 4.25[SHIFT][MODE][5][EXE]	243.5070629
Conversion of 1.23 grad to radians	[MODE][5][EXE] 1.23[SHIFT][MODE][6][EXE]	0.0193207948
Conversion of 7.89 degrees to grads	[MODE][6][EXE] 7.89[SHIFT][MODE][4][EXE]	8.766666667
Result displayed in degrees 47.3° + 82.5 rad = 4774.20181°	[MODE][4][EXE] 47.3[+]82.5[SHIFT][MODE][5][EXE]	4774.20181
12.4° + 8.3 rad − 1.8 gra = 486.33497°	12.4[+]8.3[SHIFT][MODE][5][−]1.8 [SHIFT][MODE][6][EXE]	486.33497
Result displayed in radians 24°6'31" + 85.34 rad = 85.76077464 rad	[MODE][5][EXE] 24[°'"]6[°'"]31[°'"][SHIFT][MODE][4] [+]85.34[EXE]	85.76077464
Result displayed in grads 36.9° + 41.2 rad = 2663.873462 gra	[MODE][6][EXE] 36.9[SHIFT][MODE][4][+]41.2 [SHIFT][MODE][5][EXE]	2663.873462

■Trigonometric functions and inverse trigonometric functions

- Be sure to set the unit of angular measurement before performing trigonometric function and inverse trigonometric function calculations.
- The operations noted below cannot be performed in the BASE-N mode.

Example	Operation	Display
$\sin 63°52'41'' = 0.897859012$	[MODE][4][EXE] → "D" [sin]63[°'"]52[°'"]41[°'"][EXE]	0.897859012
$\cos\left(\frac{\pi}{3}\text{ rad}\right) = 0.5$	[MODE][5][EXE] → "R" [cos]([SHIFT][π][÷]3)[EXE]	0.5
$\tan(-35\text{gra}) = -0.612800788$	[MODE][6][EXE] → "G" [tan][SHIFT][(−)]35[EXE]	−0.612800788
$2\cdot\sin 45° \times \cos 65° = 0.5976724775$	[MODE][4][EXE] → "D" 2[×][sin]45[×][cos]65[EXE] Can be omitted.	0.5976724775
$\cot 30° = \frac{1}{\tan 30°} = 1.732050808$	1[÷][tan]30[EXE]	1.732050808
$\sec\left(\frac{\pi}{3}\text{ rad}\right) = \frac{1}{\cos(\pi/3\text{rad})} = 2$	[MODE][5][EXE] → "R" 1[÷][cos]([SHIFT][π][÷]3)[EXE]	2.
$\text{cosec}30° = \frac{1}{\sin 30°} = 2$	[MODE][4][EXE] → "D" 1[÷][sin]30[EXE]	2.
$\sin^{-1}0.5 = 30°$ (Determines x for $\sin x = 0.5$)	[SHIFT][sin]0.5[EXE] Can be entered as .5.	30.
$\cos^{-1}\frac{\sqrt{2}}{2} = 0.7853981634\text{ rad} = \frac{\pi}{4}\text{ rad}$	[MODE][5][EXE] → "R" [SHIFT][cos]([√][2][÷]2)[EXE] [÷][SHIFT][π][EXE]	0.7853981634 0.25
$\tan^{-1}0.741 = 36.53844577° = 36°32'18.4''$	[MODE][4][EXE] → "D" [SHIFT][tan]0.741[EXE] [SHIFT][°'"]	36.53844577 36°32'18.4"

*If the total number of digits for degrees/minutes/seconds exceeds 11 digits, the high-order values (degrees and minutes) are given display priority, and any lower-order values are not displayed. However, the entire value is stored within the unit as a decimal value.		
$2.5 \times (\sin^{-1}0.8 - \cos^{-1}0.9)$ $= 68°13'13.53''$	2.5 × (SHIFT sin 0.8 − cos 0.9) EXE SHIFT °'''	68°13'13.53''

■Logarithmic and exponential functions

•The operations noted below cannot be performed in the BASE-N mode.

Example	Operation	Display
log 1.23 ($\log_{10}1.23$) $= 8.99051114 \times 10^{-2}$	log 1.23 EXE	0.0899051114
ln90 ($\log_e 90$) = 4.49980967	ln 90 EXE	4.49980967
log456 + ln456 = 0.4342944819 (log/ln ratio = constant M)	log 456 + ln 456 EXE	0.4342944819
$4^x = 64$ $x \cdot \log 4 = \log 64$ $x = \frac{\log 64}{\log 4} = 3$	log 64 ÷ log 4 EXE	3.
$10^{1.23} = 16.98243652$ (To obtain the anti-logarithm of common logarithm 1.23)	SHIFT 10^x 1.23 EXE	16.98243652
$e^{4.5} = 90.0171313$ (To obtain the anti-logarithm of natural logarithm 4.5)	SHIFT e^x 4.5 EXE	90.0171313
$10^4 \cdot e^{-4} + 1.2 \cdot 10^{2.3}$ $= 422.5878667$	SHIFT 10^x 4 × SHIFT e^x SHIFT (−) 4 + 1.2 × SHIFT 10^x 2.3 EXE	422.5878667
$5.6^{2.3} = 52.58143837$	5.6 x^2 2.3 EXE	52.58143837
$\sqrt[7]{123}$ $(= 123^{\frac{1}{7}})$ $= 1.988647795$	7 $\sqrt{\square}$ 123 EXE	1.988647795

$(78-23)^{-12}$ $= 1.305111829 \times 10^{-21}$	(78 − 23) x^2 SHIFT (−) 12 EXE	$^{-21}$ 1.305111829
$2 + 3 \times \sqrt[3]{64} - 4 = 10$	2 + 3 × 3 $\sqrt{\square}$ 64 − 4 EXE	10.
*x^y and $\sqrt[x]{\square}$ given calculation priority over × and ÷		
$2 \times 3.4^{(5+6.7)} = 3306232.001$	2 × 3.4 x^2 (5 + 6.7) EXE	3306232.001

■Hyperbolic functions and inverse hyperbolic functions

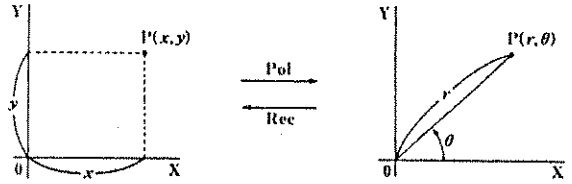
•The operations noted below cannot be performed in the BASE-N mode.

Example	Operation	Display
sinh 3.6 = 18.28545536	hyp sin 3.6 EXE	18.28545536
cosh 1.23 = 1.856761057	hyp cos 1.23 EXE	1.856761057
tanh 2.5 = 0.9866142981	hyp tan 2.5 EXE	0.9866142981
cosh 1.5 − sinh 1.5 $= 0.2231301602$ $= e^{-1.5}$	hyp cos 1.5 − hyp sin 1.5 EXE (Continuing) ln Ans EXE	0.2231301602 −1.5
(Proof of $\cosh x \pm \sinh x = e^{\pm x}$)		
$\sinh^{-1}30 = 4.094622224$	hyp SHIFT sin 30 EXE	4.094622224
$\cosh^{-1}\left(\frac{20}{15}\right) = 0.7953654612$	hyp SHIFT cos (20 ÷ 15) EXE	0.7953654612
Determine the value of x when $\tanh 4x = 0.88$ $x = \frac{\tanh^{-1}0.88}{4}$ $= 0.3439419141$	hyp SHIFT tan 0.88 ÷ 4 EXE	0.3439419141
$\sinh^{-1}2 \times \cosh^{-1}1.5$ $= 1.389388923$	hyp SHIFT sin 2 × hyp SHIFT cos 1.5 EXE	1.389388923
$\sinh^{-1}\left(\frac{2}{3}\right) + \tanh^{-1}\left(\frac{4}{5}\right)$ $= 1.723757406$	hyp SHIFT sin (2 ÷ 3) + hyp SHIFT tan (4 ÷ 5) EXE	1.723757406

■Coordinate transformation

•Your calculator lets you convert between rectangular coordinates and polar coordinates.

•Rectangular coordinates **•Polar coordinates**



•Calculation results are stored in variable memory I and variable memory J. Contents of variable memory I are displayed first. To display contents of memory J, press [ALPHA] [J] [EXE].

	I	J
Pol	r	θ
Rec	x	y

•With polar coordinates, θ can be calculated within a range of $-180° < \theta \leqq 180°$. The calculation range is the same for radians and grads.

•The operations noted below cannot be performed in the BASE-N mode.

Example	Operation	Display
If $x = 14$ and $y = 20.7$, what are r and $\theta°$?	[MODE] [4] [EXE] → "D" [SHIFT] [Pol(] 14 [SHIFT] [)] 20.7 [)] [EXE] (Continuing) [ALPHA] [J] [EXE] [SHIFT] [°'"]	24.98979792 (r) 55.92839019 55°55'42.2" (θ)
If $x = 7.5$ and $y = -10$, what are r and θ rad?	[MODE] [5] [EXE] → "R" [SHIFT] [Pol(] 7.5 [SHIFT] [)] [SHIFT] [(−)] 10 [)] [EXE] (Continuing) [ALPHA] [J] [EXE]	12.5 (r) −0.927295218 (θ)
If $r = 25$ and $\theta = 56°$, what are x and y?	[MODE] [4] [EXE] → "D" [SHIFT] [Rec(] 25 [SHIFT] [)] 56 [)] [EXE] (Continuing) [ALPHA] [J] [EXE]	13.97982259 (x) 20.72593931 (y)
If $r = 4.5$ and $\theta = \frac{2}{3}\pi$ rad, what are x and y?	[MODE] [5] [EXE] → "R" [SHIFT] [Rec(] 4.5 [SHIFT] [)] [(] 2 [÷] 3 [×] [SHIFT] [π] [)] [)] [EXE] (Continuing) [ALPHA] [J] [EXE]	−2.25 (x) 3.897114317 (y)

■Other functions ($\sqrt{\ }$, x^2, x^{-1}, $x!$, $\sqrt[3]{\ }$, Ran#, Abs)

•The operations noted below cannot be performed in the BASE-N mode.

Example	Operation	Display
$\sqrt{2} + \sqrt{5} = 3.65028154$	[√] 2 [+] [√] 5 [EXE]	3.65028154
$2^2 + 3^2 + 4^2 + 5^2 = 54$	2 [x^2] [+] 3 [x^2] [+] 4 [x^2] [+] 5 [x^2] [EXE]	54.
$\frac{1}{\frac{1}{3} - \frac{1}{4}} = 12$	[(] 3 [x^{-1}] [−] 4 [x^{-1}] [)] [x^{-1}] [EXE]	12.
8!(= 1 × 2 × 3 × ..... × 8) = 40320	8 [SHIFT] [$x!$] [EXE]	40320.
$\sqrt[3]{36 \times 42 \times 49} = 42$	[SHIFT] [$\sqrt[3]{\ }$] [(] 36 [×] 42 [×] 49 [)] [EXE]	42.
Random number generation (pseudorandom number from 0.000 to 0.999)	[SHIFT] [Ran#] [EXE]	(Ex.) 0.792
$\sqrt{13^2 - 5^2} + \sqrt{3^2 + 4^2} = 17$	[√] [(] 13 [x^2] [−] 5 [x^2] [)] [+] [√] [(] 3 [x^2] [+] 4 [x^2] [)] [EXE]	17.
$\sqrt{1 - \sin^2 40°} = 0.7660444431$ $= \cos 40°$ (Proof of $\cos\theta = \sqrt{1 - \sin^2\theta}$)	[MODE] [4] [EXE] → "D" [√] [(] 1 [−] [(] [sin] 40 [)] [x^2] [)] [EXE] (Continuing) [SHIFT] [cos] [Ans] [EXE]	0.7660444431 40.
$\frac{1}{2!} + \frac{1}{4!} + \frac{1}{6!} + \frac{1}{8!} = 0.5430803571$	2 [SHIFT] [$x!$] [x^{-1}] [+] 4 [SHIFT] [$x!$] [x^{-1}] [+] 6 [SHIFT] [$x!$] [x^{-1}] [+] 8 [SHIFT] [$x!$] [x^{-1}] [EXE]	0.5430803571
What is the absolute value of the common logarithm of $\frac{3}{4}$? $\left\lvert \log\frac{3}{4} \right\rvert = 0.1249387366$	[SHIFT] [Abs] [log] [(] 3 [÷] 4 [)] [EXE]	0.1249387366

■ Fractions

•Fractions are input and displayed in the following order: integer, numerator, denominator.

Example	Operation	Display
$\frac{2}{5}+3\frac{1}{4}=3\frac{13}{20}$	2 a$\frac{b}{c}$ 5 + 3 a$\frac{b}{c}$ 1 a$\frac{b}{c}$ 4 EXE	3⌟13⌟20.
$=3.65$	(Conversion to decimal) a$\frac{b}{c}$	3.65
[1]Fractions can be converted to decimals, and then converted back to fractions.		
$3\frac{456}{78}=8\frac{11}{13}$ (Reduced)	3 a$\frac{b}{c}$ 456 a$\frac{b}{c}$ 78 EXE	8⌟11⌟13.
	(Continuing) SHIFT d/c	115⌟13.
*Fractions and improper fractions which can be reduced become reduced fractions when a calculation command key is pressed. Press SHIFT d/c to convert to improper fraction.		
$\frac{1}{2578}+\frac{1}{4572}$		
$=6.066202547\times10^{-4}$	1 a$\frac{b}{c}$ 2578 + 1 a$\frac{b}{c}$ 4572 EXE	6.066202547^{-04} (NORM 1 mode)
*When the total number of characters, including integer, numerator, denominator and delimiter mark exceeds 10, the input fraction is automatically displayed in decimal format.		
$\frac{1}{2}\times0.5=0.25$	1 a$\frac{b}{c}$ 2 × . 5 EXE	0.25
*Calculations containing both fractions and decimals are calculated in decimal format.		
$\frac{1}{3}\times(-\frac{4}{5})-\frac{5}{6}=-1\frac{1}{10}$	1 a$\frac{b}{c}$ 3 × SHIFT (−) 4 a$\frac{b}{c}$ 5 − 5 a$\frac{b}{c}$ 6 EXE	−1⌟1⌟10.

$\frac{1}{2}\times\frac{1}{3}+\frac{1}{4}\times\frac{1}{5}=\frac{13}{60}$	1 a$\frac{b}{c}$ 2 × 1 a$\frac{b}{c}$ 3 + 1 a$\frac{b}{c}$ 4 × 1 a$\frac{b}{c}$ 5 EXE	13⌟60.
$\frac{\frac{1}{2}}{3}=\frac{1}{6}$	(1 a$\frac{b}{c}$ 2) a$\frac{b}{c}$ 3 EXE	1⌟6.
$\frac{1}{\frac{1}{3}+\frac{1}{4}}=1\frac{5}{7}$	1 a$\frac{b}{c}$ (1 a$\frac{b}{c}$ 3 + 1 a$\frac{b}{c}$ 4) EXE	1⌟5⌟7.
*Fractional calculations can be performed by using parentheses in the numerator or denominator.		

2-4 Binary, Octal, Decimal, Hexadecimal Calculations

- Binary, octal, decimal and hexadecimal calculations, conversions and logical operations are performed in the BASE-N mode (press [MODE] [▬]).
- The number system (2, 8, 10, 16) is set by respectively pressing [BIN], [OCT], [DEC] or [HEX] followed by [EXE]. A corresponding symbol — "b", "o", "d" or "H" appears on the display.
- Number systems are specified for specific values by pressing [SHIFT], then the number system designator (b, o, d, or h), immediately followed by the value.
- General function calculations cannot be performed in the BASE-N mode.
- Only integers can be handled in the BASE-N mode. If a calculation produces a result that includes a decimal value, the decimal portion is cut off.
- Octal, decimal and hexadecimal calculations can be handled up to 32 bits, while binary can be handled up to 12 bits.

Number system	Number of digits displayed
Binary	Up to 12 digits
Octal	Up to 11 digits
Decimal	Up to 10 digits
Hexadecimal	Up to 8 digits

- The total range of numbers handled in this mode is 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F. If values not valid for the particular number system are used, attach the corresponding designator (b, o, d or h), or an error message will appear.

Number system	Valid values
Binary	0, 1
Octal	0, 1, 2, 3, 4, 5, 6, 7
Decimal	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Hexadecimal	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

- Negative numbers in binary, octal and hexadecimal are expressed as two's complements.
- To distinguish the A, B, C, D, E and F used in the hexadecimal system from standard letters, they appear as shown in the chart below.

Key	Display
[A] (= [x])	A
[B] (= [←])	B
[C] (= [hyp])	C
[D] (= [sin])	D
[E] (= [cos])	E
[F] (= [tan])	F

- Calculation range (in BASE-N mode)

Binary	Positive	: $011111111111 \geqq x \geqq 0$
	Negative	: $111111111111 \geqq x \geqq 100000000000$
Octal	Positive	: $17777777777 \geqq x \geqq 0$
	Negative	: $37777777777 \geqq x \geqq 20000000000$
Decimal		$2147483647 \geqq x \geqq -2147483648$
Hexadecimal	Positive	: $7FFFFFFF \geqq x \geqq 0$
	Negative	: $FFFFFFFF \geqq x \geqq 80000000$

- You cannot specify the unit of angular measurement (degrees, radians, grads) or the display format (Fix, Sci) while the calculator is in the BASE-N mode. Such specifications can only be made if you first exit the BASE-N mode.

■Binary, octal, decimal, hexadecimal conversions

Example	Operation	Display
What are the decimal values for $2A_{16}$ and 274_8?	MODE − → "BASE-N" Dec EXE → "d"	
	SHIFT h 2A EXE	d 42
	SHIFT o 274 EXE	d 188
What are the hexadecimal values for 123_{10} and 1010_2?	Hex EXE → "H"	
	SHIFT d 123 EXE	H 0000007B
	SHIFT b 1010 EXE	H 0000000A
What are the octal values for 15_{16} and 1100_2?	Oct EXE → "o"	
	SHIFT h 15 EXE	o 00000000025
	SHIFT b 1100 EXE	o 00000000014
What are the binary values for 36_{10} and $3B7_{16}$?	Bin EXE → "b"	
	SHIFT d 36 EXE	b 000000100100
	SHIFT h 3B7 EXE	b 001110110111

■Negative expressions

Example	Operation	Display
	MODE − → "BASE-N"	
How is 110010_2 expressed as a negative?	Bin EXE → "b"	
	(−) 110010 EXE	b 111111001110
How is 72_8 expressed as a negative?	Oct EXE → "o"	
	(−) 72 EXE	o 37777777706
How is $3A_{16}$ expressed as a negative?	Hex EXE → "H"	
	(−) 3A EXE	H FFFFFFC6

■Basic arithmetic operations using binary, octal, decimal and hexadecimal values

Example	Operation	Display
	MODE − → "BASE-N"	
$10111_2 + 11010_2 = 110001_2$	Bin EXE → "b"	
	10111 + 11010 EXE	b 000000110001
$B47_{16} - DF_{16} = A68_{16}$	Hex EXE → "H"	
	B47 − DF EXE	H 00000A68
$123_8 \times ABC_{16} = 37AF4_{16}$	SHIFT o 123 × ABC EXE	H 00037AF4
$= 228084_{10}$	Dec EXE	d 228084
$1F2D_{16} - 100_{10} = 7881_{10}$	SHIFT h 1F2D − 100 EXE	d 7881
$= 1EC9_{16}$	Hex EXE	H 00001EC9
$7654_8 \div 12_{10} = 334.3333333_{10}$	Dec EXE → "d"	
$= 516_8$	SHIFT o 7654 ÷ 12 EXE	d 334
	Oct EXE	o 00000000516

*Calculation results are displayed with the decimal portion cut off.

$1234_{10} + 1EF_{16} \div 24_8$	SHIFT d 1234 + SHIFT h	
$= 2352_8$	1EF ÷ 24 EXE	o 00000002352
$= 1258_{10}$	Dec EXE	d 1258

*For mixed basic arithmetic operations, multiplication and division are given priority over addition and subtraction.

■Logical operations

Logical operations are performed through logical products (and), logical sums (or), negation (Not), exclusive logic sums (xor), and negation of exclusive logical sums (xnor).

Example	Operation	Display
	MODE ▬ → "BASE-N"	
19_{16} AND $1A_{16} = 18_{16}$	Hex EXE → "H" 19 and 1A EXE	H 00000018
1110_2 AND $36_8 = 1110_2$	Bin EXE → "b" 1110 and SHIFT O 36 EXE	b 000000001110
23_8 OR $61_8 = 63_8$	Oct EXE → "o" 23 or 61 EXE	o 00000000063
120_{16} OR $1101_2 = 12D_{16}$	Hex EXE → "H" 120 or SHIFT b 1101 EXE	H 0000012D
1010_2 AND (A_{16} OR 7_{16}) $= 1010_2$	Bin EXE → "b" 1010 and (SHIFT h A or SHIFT h 7) EXE	b 000000001010
5_{16} XOR $3_{16} = 6_{16}$	Hex EXE → "H" 5 SHIFT xor 3 EXE	H 00000006
$2A_{16}$ XNOR $5D_{16} = FFFFFF88_{16}$	Hex EXE → "H" 2A SHIFT xnor 5D EXE	H FFFFFF88
Negation of 1234_8	Oct EXE → "o" Not 1234 EXE	o 37777776543
Negation of $2FFFED_{16}$	Hex EXE → "H" Not 2FFFED EXE	H FFD00012

2-5 Statistical Calculations

■Standard deviation

- Standard deviation calculations are performed in the SD1 mode (MODE ■). "SD1" appears on the display.
- Before beginning calculations, the statistical memories are cleared by pressing SHIFT followed by Scl and then EXE.
- Individual data are input using DT.
- Multiple data of the same value can be input either by repeatedly pressing DT or by entering the data, pressing SHIFT, followed by ;, that represents the number of times the data is repeated, and then DT.

•Standard Deviation

$$\sigma_n = \sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n}} = \sqrt{\frac{\Sigma x^2-(\Sigma x)^2/n}{n}}$$

[Using all data from a finite population to determine the standard deviation for the population]

$$\sigma_{n-1} = \sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n-1}} = \sqrt{\frac{\Sigma x^2-(\Sigma x)^2/n}{n-1}}$$

[Using sample data from a population to determine the standard deviation for the population]

•Mean

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{\Sigma x}{n}$$

**The values for n, Σx, and Σx^2 are stored in memories W, V, and U respectively, and can be obtained by pressing ALPHA followed by the memory name and then EXE (i.e. ALPHA W EXE).*

Example	Operation	Display
Data 55, 54, 51, 55, 53, 53, 54, 52	MODE ■ SHIFT Scl EXE (Clears memory)	
	55 DT 54 DT 51 DT 55 DT 53 DT DT 54 DT 52 DT	52.
*You can press the function keys to obtain results in any sequence.		
	(Standard deviation σ_n) SHIFT $x\sigma_n$ EXE	1.316956719
	(Standard deviation σ_{n-1}) SHIFT $x\sigma_{n-1}$ EXE	1.407885953

To calculate the deviation of the unbiased variance, the difference between each datum, and mean of the above data

(Mean $\bar{x}$) SHIFT $\bar{x}$ EXE	53.375
(Number of data n) ALPHA W EXE	8.
(Sum total Σx) ALPHA V EXE	427.
(Sum of squares Σx^2) ALPHA U EXE	22805.
(Continuing) SHIFT $x\sigma_{n-1}$ $\bar{x}$ EXE	1.982142857
55 ▬ SHIFT $\bar{x}$ EXE	1.625
54 ▬ SHIFT $\bar{x}$ EXE	0.625
51 ▬ SHIFT $\bar{x}$ EXE	−2.375
⋮	⋮

To calculate x and σ_{n-1} for the following data

Class no.	Value	Frequency
1	110	10
2	130	31
3	150	24
4	170	2
5	190	3

SHIFT Scl EXE	
110 SHIFT : 10 DT	110.
130 SHIFT : 31 DT	130.
150 SHIFT : 24 DT	150.
170 DT DT	170.
190 DT DT DT	190.
ALPHA W EXE	70.
SHIFT $\bar{x}$ EXE	137.7142857
SHIFT $x\sigma_{n-1}$ EXE	18.42898069

*Erroneous data clearing/correction I (correct data operation: 51 DT)
① If 50 DT is entered, enter correct data after pressing CL.
② If 49 DT was input a number of entries previously, enter correct data after pressing 49 CL.

*Erroneous data clearing/correction II (correct data operation: 130 SHIFT : 31 DT)
① If 120 SHIFT : is entered, enter correct data after pressing AC.
② If 120 SHIFT : 31 is entered, enter correct data after pressing AC.
③ If 120 SHIFT : 30 DT is entered, enter correct data after pressing CL.
④ If 120 SHIFT : 30 DT was entered previously, enter correct data after pressing 120 SHIFT : 30 CL.

■Regression calculation

- Regression calculations are performed in the LR1 mode (MODE ▬). "LR1" appears on the display.
- Before beginning calculations, the tabulation memories are cleared by pressing SHIFT followed by Scl and then EXE.
- Individual data are entered as x data SHIFT , y data DT.
- Multiple data of the same value can be entered by repeatedly pressing DT. This operation can also be performed by entering x data SHIFT , y data SHIFT : followed by a value representing the number of times the data is repeated, and then DT.
- If only x data is repeated (x data having the same value), enter SHIFT , y data DT or SHIFT , y data SHIFT : followed by a value representing the number of times the data is repeated, and then DT.
- If only y data is repeated (y data having the same value), enter x data DT or x data SHIFT : followed by a value representing the total number of times the data is repeated, and then DT.

• Regression

The following are the formulas the unit uses to calculate constant term A and regression coefficient B for the regression formula $y = A + Bx$.

Constant term of regression formula

$$A = \frac{\Sigma y - B \cdot \Sigma x}{n}$$

Regression coefficient of regression formula

$$B = \frac{n \cdot \Sigma xy - \Sigma x \cdot \Sigma y}{n \cdot \Sigma x^2 - (\Sigma x)^2}$$

- Estimated value $\hat{x}$, and $\hat{y}$ based on the regression formula can be calculated using the following formulas:

$$\hat{y} = A + Bx \qquad \hat{x} = \frac{y - A}{B}$$

(To obtain the estimated value $\hat{y}$, SHIFT 2 is used, and to obtain estimated value $\hat{x}$, SHIFT $\bar{x}$ is used.)

- The correlation coefficient r for input data can be calculated using the following formula:

$$r = \frac{n \cdot \Sigma xy - \Sigma x \cdot \Sigma y}{\sqrt{[n \cdot \Sigma x^2 - (\Sigma x)^2]\,[n \cdot \Sigma y^2 - (\Sigma y)^2]}}$$

The values for n, Σx, Σx^2, Σxy, Σy, and Σy^2 are stored in memories W, V, U, R, Q and P respectively, and can be obtained by pressing ALPHA followed by the memory name and then EXE (i.e. ALPHA W EXE).

■Linear regression

Example	Operation	Display
•Relationship between temperature and the length of a steel bar	MODE ▬	
	SHIFT Scl EXE (Clears memory)	
	10 SHIFT , 1003 DT	10.
	15 SHIFT , 1005 DT	15.
	20 SHIFT , 1010 DT	20.
	25 SHIFT , 1011 DT	25.
	30 SHIFT , 1014 DT	30.
	(Constant term A) SHIFT A EXE	997.4
	(Regression coefficient B) SHIFT B EXE	0.5
	(Correlation coefficient r) SHIFT r EXE	0.982607368
	(Length at 18°C) 18 SHIFT y EXE	1007.4
	(Temperature at 1000mm) 1000 SHIFT x EXE	4.64285714
	(Critical coefficient) SHIFT r x² EXE	0.965517241
	(Covariance) (ALPHA R ▬ ALPHA W ✕ SHIFT x̄ ✕ SHIFT ȳ) ▬ (ALPHA W ▬ 1) EXE	35

Temperature	Length
10°C	1003mm
15°C	1005mm
20°C	1010mm
25°C	1011mm
30°C	1014mm

The data in the above table can be used to obtain the terms of the regression formula and the correlation coefficient. Based on the regression formula, the estimated length of the steel bar at 18°C and the temperature when the bar is 1000 mm long can be calculated. The critical coefficient (r^2) and covariance

$$\left(\frac{\Sigma xy - n \cdot \bar{x} \cdot \bar{y}}{n-1}\right)$$

can also be calculated.

*Erroneous data clearing/correction (correct data operation: 10 SHIFT , 1003 DT)

①If 11 SHIFT , 1003 is entered, enter correct data after pressing AC.

②If 11 SHIFT , 1003 DT is entered, enter correct data after pressing CL.

③If 11 SHIFT , 1003 DT was entered previously, enter correct data after pressing 11 SHIFT , 1003 CL.

■Logarithmic regression

The regression formula is $y = A + B \cdot \ln x$. Enter the x data as the logarithm (ln) of x, and the y data inputs the same as that for linear regression.

Estimated values $\hat{x}$, and $\hat{y}$ based on the regression formula can be calculated using the following formulas:

$$\hat{y} = A + B \cdot \ln x \qquad \hat{x} = \exp\left(\frac{y - A}{B}\right)$$

The same operation as with linear regression can be used to obtain the regression coefficient and for making corrections. To obtain the estimated value $\hat{y}$, ln x SHIFT 1 EXE is used, and to obtain estimated value $\hat{x}$, y SHIFT 1 EXE SHIFT e^x Ans EXE is used.

Furthermore, Σx, Σx^2 and Σxy are obtained by $\Sigma \ln x$, $\Sigma(\ln x)^2$, and $\Sigma \ln x \cdot y$ respectively.

Example	Operation	Display
	MODE ▬	
	SHIFT Scl EXE (Clears memory)	
	ln 29 SHIFT , 1.6 DT	3.36729583
	ln 50 SHIFT , 23.5 DT	3.912023005
	ln 74 SHIFT , 38.0 DT	4.304065093
	ln 103 SHIFT , 46.4 DT	4.634728988
	ln 118 SHIFT , 48.9 DT	4.770684624
	(Constant term A) SHIFT A EXE	−111.1283976
	(Regression coefficient B) SHIFT B EXE	34.02014749
	(Correlation coefficient r) SHIFT r EXE	0.9940139464
	($\hat{y}$ when $xi = 80$) ln 80 SHIFT 1 EXE	37.94879482
	($\hat{x}$ when $yi = 73$) 73 SHIFT 2 EXE SHIFT e^x Ans EXE	224.1541314

xi	yi
29	1.6
50	23.5
74	38.0
103	46.4
118	48.9

The data in the above table can be used to obtain the terms of the regression formula and the correlation coefficient. Based on the regression formula, estimated value $\hat{y}$ can be obtained for $xi = 80$, and estimated value $\hat{x}$ can be obtained for $yi = 73$.

■Exponential regression

- The regression formula is $y = A \cdot e^{B \cdot x}$ ($\ln y = \ln A + Bx$). Enter the y data as the logarithm of y(ln), and the x data the same as that for linear regression.
- Estimated values $\hat{x}$, and $\hat{y}$ based on the regression formula can be calculated using the following formulas:

$$\hat{y} = A \cdot e^{Bx} \qquad \hat{x} = \frac{\ln y - \ln A}{B}$$

- Correction is performed the same as in linear regression. Constant term A is obtained by [SHIFT][e^x][SHIFT][A][EXE], estimated value $\hat{y}$ is obtained by x[SHIFT][2][EXE][SHIFT][e^x][Ans][EXE], and estimated value $\hat{x}$ is obtained by [ln]y[SHIFT][1][EXE]. Σy, Σy^2 and Σxy are obtained by $\Sigma \ln y$, $\Sigma(\ln y)^2$ and $\Sigma x \cdot \ln y$ respectively.

Example

xi	yi
6.9	21.4
12.9	15.7
19.8	12.1
26.7	8.5
35.1	5.2

The data in the above table can be used to obtain the terms of the regression formula and the correlation coefficient. Based on the regression formula, estimated value $\hat{y}$ can be obtained for $xi = 16$, and estimated value $\hat{x}$ can be obtained for $yi = 20$.

Operation	Display
[MODE][1]	
[SHIFT][Scl][EXE] (Clears memory)	
6.9[SHIFT][,][ln]21.4[DT]	6.9
12.9[SHIFT][,][ln]15.7[DT]	12.9
19.8[SHIFT][,][ln]12.1[DT]	19.8
26.7[SHIFT][,][ln]8.5[DT]	26.7
35.1[SHIFT][,][ln]5.2[DT]	35.1
(Constant term A) [SHIFT][e^x][SHIFT][A][EXE]	30.49758742
(Regression coefficient B) [SHIFT][B][EXE]	−0.049203708
(Correlation coefficient r) [SHIFT][r][EXE]	−0.997247351
($\hat{y}$ when $xi = 16$) 16[SHIFT][2][EXE][SHIFT][e^x][Ans][EXE]	13.87915739
($\hat{x}$ when $yi = 20$) [ln]20[SHIFT][1][EXE]	8.574868046

■Power regression

- The regression formula is $y = A \cdot x^B$ ($\ln y = \ln A + B \ln x$). Enter both data x and y as logarithms (ln).
- Estimated values $\hat{x}$, and $\hat{y}$ based on the regression formula can be calculated using the following formulas:

$$\hat{y} = A \cdot x^B \qquad \hat{x} = \exp\left(\frac{\ln y - \ln A}{B}\right)$$

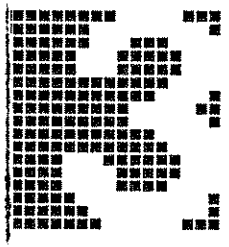
- Correction is performed the same as in linear regression. Constant term A is obtained by [SHIFT][e^x][SHIFT][A][EXE], estimated value $\hat{y}$ is obtained by [ln]x[SHIFT][2][EXE][SHIFT][e^x][Ans][EXE], and estimated value $\hat{x}$ is obtained by [ln]y[SHIFT][1][EXE][SHIFT][e^x][Ans][EXE]. Σx, Σx^2, Σy, Σy^2 and Σxy are obtained by $\Sigma \ln x$, $\Sigma(\ln x)^2$, $\Sigma \ln y$, $\Sigma(\ln y)^2$ and $\Sigma \ln x \cdot \ln y$ respectively.

Example

xi	yi
28	2410
30	3033
33	3895
35	4491
38	5717

The data in the above table can be used to obtain the terms of the regression formula and the correlation coefficient. Based on the regression formula, estimated value $\hat{y}$ can be obtained for $xi = 40$, and estimated value $\hat{x}$ can be obtained for $yi = 1000$.

Operation	Display
[MODE][1]	
[SHIFT][Scl][EXE] (Clears memory)	
[ln]28[SHIFT][,][ln]2410[DT]	3.33220451
[ln]30[SHIFT][,][ln]3033[DT]	3.401197382
[ln]33[SHIFT][,][ln]3895[DT]	3.496507561
[ln]35[SHIFT][,][ln]4491[DT]	3.555348061
[ln]38[SHIFT][,][ln]5717[DT]	3.63758616
(Constant term A) [SHIFT][e^x][SHIFT][A][EXE]	0.2388010829
(Regression coefficient B) [SHIFT][B][EXE]	2.771866148
(Correlation coefficient r) [SHIFT][r][EXE]	0.9989062562
($\hat{y}$ when $xi = 40$) [ln]40[SHIFT][2][EXE][SHIFT][e^x][Ans][EXE]	6587.674743
($\hat{x}$ when $yi = 1000$) [ln]1000[SHIFT][1][EXE]	
[SHIFT][e^x][Ans][EXE]	20.26225659



Graphs

3-1 Built-in Function Graphs
3-2 User Generated Graphs
3-3 Some Graphing Examples
3-4 Single-Variable Statistical Graphs
3-5 Paired-Variable Statistical Graphs

The innovative graphing function of this calculator employs a dot display that gives you detailed representation of mathematical functions and statistics. In addition to using the built-in functions, you can also graph any function by simply inputting its formula.

3-1 Built-in Function Graphs

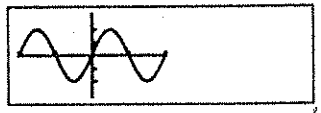
The COMP mode of the RUN mode should be used when graphing functions. Some graphs can be produced in the SD and LR modes, but certain graphs cannot be produced in these modes. The BASE-N mode cannot be used for graphs. This unit contains a total of 20 built-in graphs making it possible to produce the graphs of basic functions.

•sin	•cos	•tan	•$\sin^{-1}$	•$\cos^{-1}$	•$\tan^{-1}$
•sinh	•cosh	•tanh	•$\sinh^{-1}$	•$\cosh^{-1}$	•$\tanh^{-1}$
•$\sqrt{\ }$	•x^2	•log	•ln	•10^x	•e^x
•x^{-1}	•$\sqrt[3]{\ }$				

Any time a built-in graph is executed, the ranges (see page 74) are automatically set to their optimum values, and any graph previously on the display is cleared.

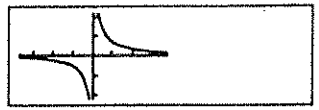
Example 1 Sine curve

MODE ✚
Graph sin EXE



Example 2 $y = \frac{1}{x}$ graph

Graph x^{-1} EXE



■Overdrawing built-in function graphs

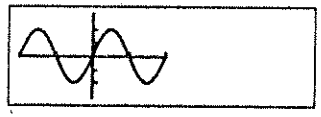
Two or more different built-in function graphs can be drawn together on the same display. Since the range for the first graph is automatically set, all subsequent graphs on the same display are produced according to the range of the first graph. The first graph is produced by using the previously mentioned operation (Graph [function key] EXE).

Subsequent graphs are produced using the variable X in the operation Graph [function key] ALPHA X EXE. By inputting ALPHA X after the function key, the range is unchanged and the next graph is produced without clearing the existing display (see page 79).

Example **Overdraw the graph for $y = \cos x$ on the graph for $y = \sin x$.**

First, draw the graph for $y = \sin x$.

Graph sin EXE



Next, draw the graph for $y = \cos x$ without changing the existing range.

Graph cos ALPHA X EXE

〈Note〉

Built-in function graphs cannot be used in multistatements (see page 49).

3-2 User Generated Graphs

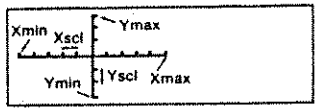
Built-in function graphs can also be used in combination with each other. Graphing a formula such as $y = 2x^2 + 3x - 5$ makes it possible to visually represent the solution.
Unlike built-in functions, the ranges of user generated graphs are not set automatically, so graphs produced outside of the display range do not appear on the display.

■Range parameters

After pressing the [Range] key, you can look up and specify the range parameters for the *x*- and *y*- coordinates. Range parameters consist of maximum and minimum values for each axis, as well as their scales (distance between hash marks). Before drawing a graph, you should first specify range parameters to set the size of the graph.

•Range parameter types

Range parameters consist of the following:



Xmin — minimum value of the *x*-axis
Xmax — maximum value of the *x*-axis
Xscl — scale of the *x*-axis
Ymin — minimum value of the *y*-axis
Ymax — maximum value of the *y*-axis
Yscl — scale of the *y*-axis

•Specifying range parameters

Whenever you press the [Range] key (except in the BASE-N mode), the range parameter setting screen appears on the display. Enter the value you want to specify for the displayed parameter and then press [EXE].

Example **Change the range parameters on the left to those on the right.**

Xmin: 0 → −5　　Ymin: −10 → −5
Xmax: 5 → 5　　Ymax: 10 → 15
Xscl: 4 → 2　　Yscl: 4 → 4

[Range]

Xmin?
0.

Specifies −5 for Xmin.
[SHIFT] [(−)] [5]

Xmin?
-5

[EXE]

Xmax?
5.

Xmax does not change, so simply press [EXE].
[EXE]

Xscl?
4.

Specifies 2 for Xscl.
[2] [EXE]

Ymin?
-10.

Specifies −5 for Ymin.
[SHIFT] [(−)] [5] [EXE]

Ymax?
10.

Specifies 15 for Ymax.
[1] [5] [EXE]

Yscl?
4.

Yscl does not change, so simply press [EXE].
[EXE]

•Checking range parameters

Press the [Range] key and the range parameter setting screen appears on the display. Press [EXE] to scroll through the range parameter settings without changing them.

[Range]

```
Xmin?
          -5.
```

[EXE]

```
Xmax?
           5.
```

[EXE]

```
Xscl?
           2.
```

[EXE]

```
Ymin?
          -5.
```

[EXE]

```
Ymax?
          15.
```

[EXE]

```
Yscl?
           4.
```

Press [Range] to return to the display that was shown before entering the range display.

You can input range parameters as expressions (such as 2π) and these expressions are automatically converted to the values.

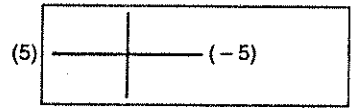
*The input range for graph ranges is $-9.999999999\varepsilon+97$ through $9.999999999\varepsilon+97$.

*If you enter a value that is outside the allowable range or if you try to perform some other illegal operation, an error message appears on the display. When this happens, press [◄] or [►] to display the place in the calculation that caused the error (Replay function) and make the necessary corrections.

*Inputting 0 for Xscl or Yscl does not set any scale.

*Inputting a maximum value that is less than the minimum value will reverse the respective axis.

Example **Xmin: 5**
Xmax: –5



*If the maximum and minimum values of an axis are equal, an error (Ma ERROR) will be generated when an attempt is made to produce a graph.

*When a range setting is used that does not allow display of the axes, the scale for the y-axis is indicated on either the left or right edge of the display, while that for the x-axis is indicated on either the top or bottom edge. (In both cases, the location of the scale is the edge which is closest to the origin (0, 0)).

*When range values are changed (reset), the graph display is cleared and the newly set axes only are displayed.

*Range settings may cause irregular scale spacing.

*If the range is set too wide, the graph produced may not fit on the display.

*Points of deflection sometimes exceed the capabilities of the display with graphs that change drastically as they approach the point of deflection.

*An Ma ERROR is generated when ranges are extremely narrow.

•Range reset

Range values are reset to their initial values by pressing [SHIFT][Mcl] during range display.

The initial values are as follows.

Xmin :	−3.8	Ymin :	−2.2
Xmax :	3.8	Ymax :	2.2
Xscl :	1	Yscl :	1

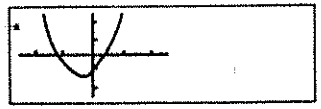
■User generated function graphs

After performing range settings, user generated graphs can be drawn simply by entering the function (formula) after pressing [Graph].
Here, let's try drawing a graph for $y=2x^2+3x-4$.
Set the ranges to the values shown below.

Xmin :	−5	Ymin :	−10
Xmax :	5	Ymax :	10
Xscl :	2	Yscl :	4

Input the functional formula after pressing the [Graph] key.

[Graph][2][ALPHA][X][x^2][+]
[3][ALPHA][X][−][4][EXE]



The result produces a visual representation of the formula.

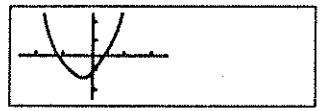
■Function graph overdraw

Two or more function graphs can be overdrawn, which makes it easy to determine intersection points and solutions that satisfy all the equations.

Example **Here, let's find the intersection points of the previously used $y=2x^2+3x-4$ and $y=2x+3$.**

First, clear the graph screen in preparation for the first graph.

[SHIFT][Cls][EXE]
[Graph][2][ALPHA][X][x^2][+]
[3][ALPHA][X][−][4][EXE]



Next, overdraw the graph for $y=2x+3$.

[Graph][2][ALPHA][X][+][3][EXE]

In this way it can be easily seen that there are two intersections for the two function graphs. The approximate coordinates for these two intersections can be found using the Zoom function and the Trace function described in the following section.

**Be sure to input variable X ([ALPHA][X]) into the formula when using built-in graphs for overdraw.*
If variable X is not included in the second formula, the second graph is produced after clearing the first graph.

■Zoom function

This function lets you enlarge or reduce the x- and y-coordinates. If you use the Trace or Plot function to locate the pointer at a specific point on the graph, the enlargement/reduction is performed using the pointer location as the center point.

•Enlarging a graph

Example **To enlarge the graph for $y = \sin x$ by a factor of 1.5 on the x-axis and 2.0 on the y-axis. Use the following range parameters for the original graph.**

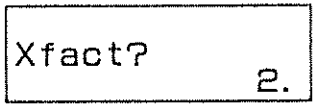
Xmin	: −360	Ymin	: −1.6
Xmax	: 360	Ymax	: 1.6
Xscl	: 180	Yscl	: 1

After specifying the range parameters, graph $y = \sin x$.

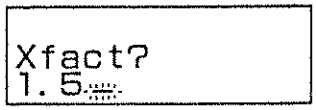
[Graph] [sin] [ALPHA] [X] [EXE]

Press [SHIFT] [Factor] for the factor specification screen.

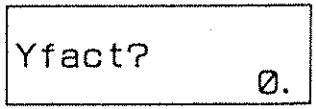
[SHIFT] [Factor]



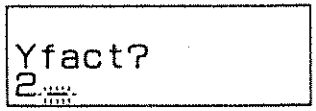
[1] [•] [5]



[EXE]



[2]



[EXE]

•Whenever you try to change the factor value while a graph is displayed, the display changes to the text screen automatically. To return to the graph screen after changing the factor value, press [G↔T] or [EXE].

[EXE] (or [G↔T])

Press [Zoom×f] to enlarge the graph according to the factors you specified.

[Zoom×f]

Let's take another look at the range parameters.

Xmin	: −240	Ymin	: −0.8
Xmax	: 240	Ymax	: 0.8
Xscl	: 180	Yscl	: 1

If you press [Zoom×f] again, the graph is enlarged once more by the factors you specified. To return the graph to its original size, press [SHIFT] [Zoom Org].

•Reducing a graph

Example **To reduce the graph for $y = \sin x$ by a factor of 1.5 on the x-axis and 2.0 on the y-axis. Use the following range parameters for the original graph.**

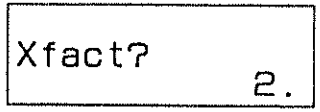
Xmin	: −360	Ymin	: −1.6
Xmax	: 360	Ymax	: 1.6
Xscl	: 180	Yscl	: 1

After specifying the range parameters, graph $y = \sin x$.

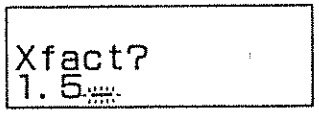
[SHIFT] [Cls] [EXE]
[Graph] [sin] [ALPHA] [X] [EXE]

Press [SHIFT] [Factor] for the factor specification screen.

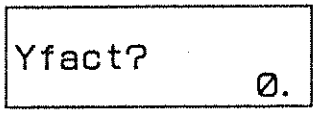
[SHIFT] [Factor]



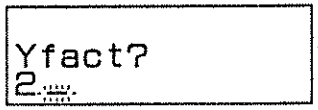
[1] [·] [5]



[EXE]



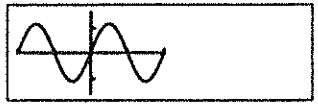
[2]



[EXE]

Whenever you try to change the factor value while a graph is displayed, the display changes to the text screen automatically. To return to the graph screen after changing the factor value, press [G↔T] or [EXE].

[EXE] (or [G↔T])



Press [SHIFT] [Zoom ×½] to reduce the graph according to the factors you specified.

[SHIFT] [Zoom ×½]

Let's take another look at the range parameters.

Xmin	: −540	Ymin	: −3.2
Xmax	: 540	Ymax	: 3.2
Xscl	: 180	Yscl	: 1

If you press [SHIFT] [Zoom ×½] again, the graph is reduced once more by the factors you specified. To return the graph to its original size, press [SHIFT] [Zoom Org].

■Trace function

This function lets you move a pointer around a graph and display the x- and y-coordinates of the current pointer location. You enlarge or reduce the x- and y-coordinates. You can display the coordinates using either seven digits or eleven digits (including negative sign).

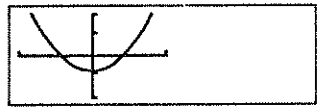
•Using the trace function

Example **To use the Trace function in combination with the Zoom function to analyze the graph for $y = x^2 - 3$. Use the following range parameters for the original graph.**

Xmin	: −4	Ymin	: −8
Xmax	: 4	Ymax	: 8
Xscl	: 2	Yscl	: 4

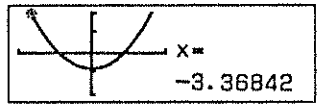
After specifying the range parameters, graph $y = x^2 - 3$.

[SHIFT] [Cls] [EXE]
[Graph] [ALPHA] [X] [x^2] [−] [3] [EXE]



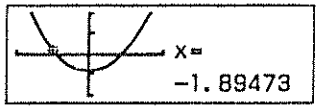
Activate the Trace function.

[Trace]



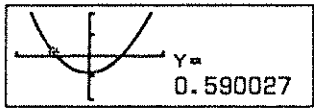
Use [→] and [←] to move the pointer along the graph. Each press moves the cursor one point. Holding down either key moves the pointer at high speed.

[→] ~ (Hold down.)

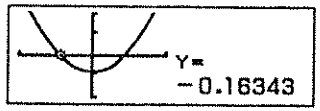


Move the pointer to the point where the graph intersects the x-axis. Note that this point will be represented by a y-axis value of 0, so first press [SHIFT] [X↔Y] to change the coordinate display to show the y-coordinate.

[SHIFT] [X↔Y]

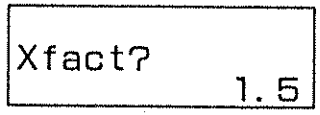


[⇨]

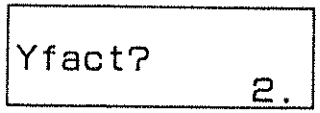


Now use the Zoom function to enlarge the graph. First specify a factor of 2 on the *x*- and *y*-axes.

[SHIFT] [Factor]



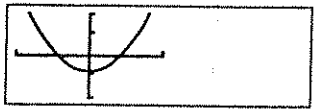
[2] [EXE]



[2] [EXE]

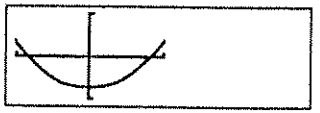
**Whenever you try to change the factor value while a graph is displayed, the display changes to the text screen automatically. To return to the graph screen after changing the factor value, press [G↔T] or [EXE].*

[EXE] (or [G↔T])



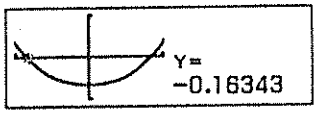
Now enlarge the graph according to the factors.

[Zoom×f]



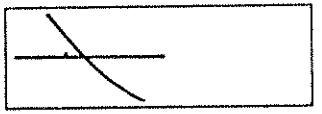
Activate the Trace function and move the pointer again.

[Trace] [SHIFT] [X↔Y]
[⇨]



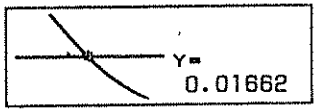
Enlarge the graph again to check the location of the pointer.

[Zoom×f]



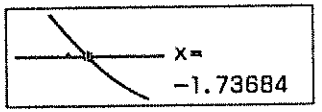
Activate the Trace function and move the pointer again.

[Trace] [SHIFT] [X↔Y]
[⇨] ~ (Hold down)



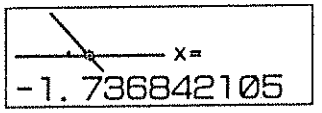
View the *x*-coordinate value.

[SHIFT] [X↔Y]



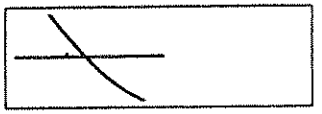
Press [SHIFT] [Value] to display the *x*-coordinate.

[SHIFT] [Value]



Press [Trace] again to exit the Trace function.

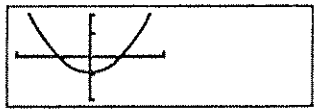
[Trace]



As you can see above, the Trace and Zoom functions can be used to locate the pointer at an approximate point, and then [SHIFT][Value] produces a readout of the coordinates.

To return the graph to its original size, press [SHIFT][Zoom Org].

[SHIFT][Zoom Org]



〈Important〉
The pointer does not move at fixed intervals. It follows the dots on the display. Because of this, the values provided for coordinates are approximate.

- **The Trace function can only be used immediately after a graph is drawn. This function cannot be used if other calculations or operations (except [Range], [Factor] and [G↔T]) have been employed after a graph has been drawn.*
- **The x-y coordinate values consist of a 11-digit (max.) mantissa or a 7-digit (max.) mantissa plus a 2-digit exponent. Negative values are one digit shorter because one digit is used for the negative sign.*
- **The Trace function can be used during a "Disp" display.*
- **When the format: "[Graph] formula ◢ [Graph] formula [EXE]" is executed and a graph is drawn by pressing [EXE] directly after executing the Trace function during halt status, the previous coordinate value remains on the display. After the Trace function is executed and the text display is brought up using the [G↔T] key, pressing [EXE] causes the next graph to appear and the coordinate value to clear.*
  Examine the above using [Graph][ALPHA][X][x²][ALPHA]◢[Graph]2[ALPHA][X]+5.

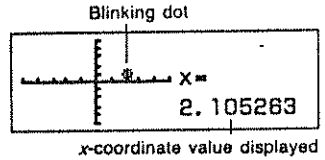
■Plot function

The Plot function is used to mark a point on the screen of a graph display. The point can be moved left, right, up and down using the cursor keys, and the coordinates for the graph displayed can be read. Two points can also be connected by a straight line (see Line function, page 89).
Press [SHIFT][Plot] and specify the *x*- and *y*-coordinates after the "Plot" message.

Example **Plot a point at $x = 2$ and $y = 2$ on the axes created by the following range values:**

Xmin :	−5	Ymin :	−10
Xmax :	5	Ymax :	10
Xscl :	1	Yscl :	2

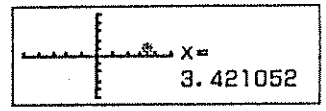
[SHIFT][Plot][2][SHIFT][,][2][EXE]



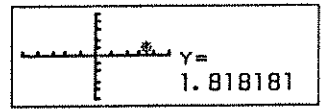
The blinking pointer is positioned at the specified coordinates.
**Due to limitations caused by the resolution of the display, the actual position of the pointer can only be approximate.*

The pointer can be moved left, right, up and down using the cursor keys. The current position of the pointer is always shown at the bottom of the display.

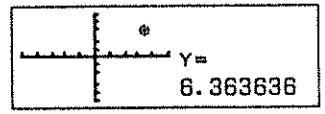
[→][→][→][→][→]



To find the *y*-coordinate value:
[SHIFT][X↔Y]

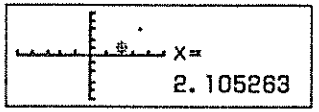


[↑][↑][↑][↑][↑]



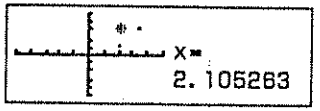
When the pointer is at the location you want, press [EXE] to plot a point. At this time, the pointer returns to the original point you specified (2, 2 in this example).

[EXE]



Now, inputting a new coordinate value causes the new pointer to blink without clearing the present pointer.

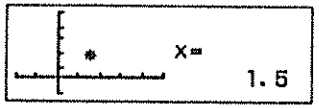
[SHIFT] [Plot] [2] [SHIFT] [,]
[6] [.] [5] [EXE]



If *x*-*y* coordinates are not specified for the Plot function, the pointer appears at the center of the screen.
Set the following range values:

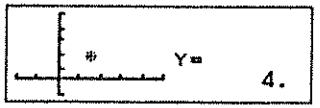
Xmin	: −2	Ymin	: −2
Xmax	: 5	Ymax	: 10
Xscl	: 1	Yscl	: 2

[SHIFT] [Plot] [EXE]



To find the *y*-coordinate value:

[SHIFT] [X↔Y]



**Attempting to plot a point outside of the preset range is disregarded.*
**The x- and y-coordinates of the pointer used in the Plot function are respectively stored in the X memory and Y memory.*
**A blinking pointer becomes a fixed point (not blinking) when a new pointer is created.*

■Line function

The Line function makes it possible to connect two points (including the blinking pointer) created with the Plot function with a straight line. With this function, user generated lines can be added to graphs to make them easier to read.

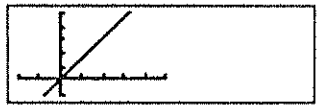
Example **Draw perpendiculars from point (2,0) on the *x*-axis to its intersection with the graph for $y = 3x$. Then draw a line from the point of intersection to the *y*-axis.**

The range values for the graph are as follows:

Xmin	: −2	Ymin	: −2
Xmax	: 5	Ymax	: 10
Xscl	: 1	Yscl	: 2

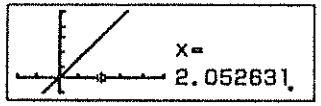
Clear the graph display and draw the graph for $y = 3x$.

[SHIFT] [Cls] [EXE]
[Graph] [3] [ALPHA] [X] [EXE]



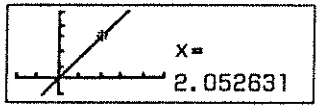
Next, use the Plot function to locate a point at (2,0).

[SHIFT] [Plot] [2] [SHIFT] [,] [0] [EXE]



Now plot a point at (2,0) again and use the cursor key ([⌂]) to move the pointer up to the point on the graph ($y = 3x$).

[SHIFT] [Plot] [2] [SHIFT] [,] [0] [EXE]
[⌂] ~ [⌂]
(Move the pointer up to the point on the graph for $y = 3x$.)

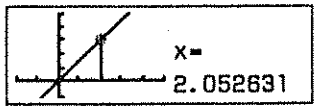


Draw a line using the Line function.

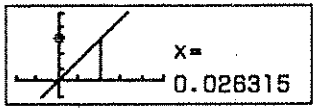
[SHIFT] [Line] [EXE]

Next, a perpendicular will be drawn from the same point on the graph to the *y*-axis. First, plot the point on the graph and use the cursor key (⇦) to move the pointer to the *y*-axis. This can be accomplished using Plot X, Y since the *x*-*y* coordinates of the point on the graph are stored in the X and Y memories.

SHIFT Plot ALPHA X SHIFT) ALPHA Y EXE



⇦ ~ ⇦
(Move the pointer to the *y*-axis.)



SHIFT Line EXE

**The Line functon can only be used to draw lines between the blinking pointer and a fixed point created using the Plot function.*

■Graph scroll function

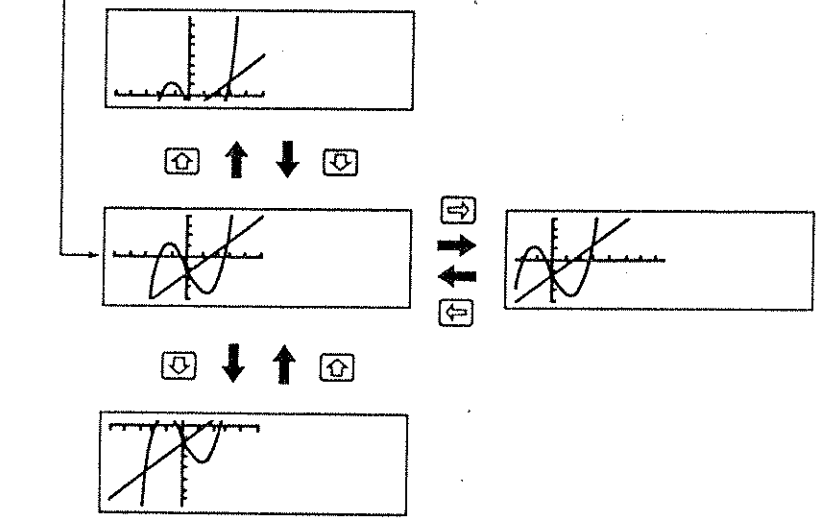
Immediately after you have drawn a graph, you can scroll it on the display. Use the cursor keys to scroll the graph left, right, up and down.

•To scroll the graph on the display

Example **To draw the graph for $y = 0.25(x+2)(2x+1)(2x-5)$, $y = 2x-3$, and then scroll it.**

Xmin	: −5	Ymin	: −8
Xmax	: 5	Ymax	: 8
Xscl	: 1	Yscl	: 2

SHIFT CIs EXE
Graph 0 • 2 5 (ALPHA X + 2)
(2 ALPHA X + 1) (2 ALPHA X
− 5) :
Graph 2 ALPHA X − 3 EXE



•Press SHIFT Zoom Org to return the graph to its original position after scroll operations.

3-3 Some Graphing Examples

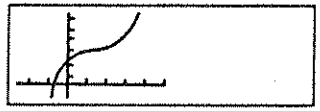
The following examples are presented to show you some ways that the graphing functions can be used effectively.

Example 1 **To graph the function $y = x^3 - 9x^2 + 27x + 50$**

Use the following range parameters.

Xmin :	−5	Ymin :	−30
Xmax :	10	Ymax :	150
Xscl :	2	Yscl :	20

[SHIFT] [Cls] [EXE]
[Graph] [ALPHA] [X] [x^2] [3] [−]
[9] [ALPHA] [X] [x^2] [+]
[2] [7] [ALPHA] [X] [+] [5] [0] [EXE]

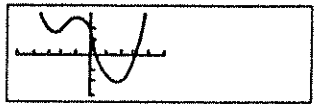


Example 2 **To graph the function $y = x^4 + 4x^3 - 36x^2 - 160x + 300$ and determine its minimum and maximum**

Use the following range parameters.

Xmin :	−10	Ymin :	−600
Xmax :	10	Ymax :	600
Xscl :	2	Yscl :	200

[SHIFT] [Cls] [EXE]
[Graph] [ALPHA] [X] [x^2] [4] [+]
[4] [ALPHA] [X] [x^2] [3] [−]
[3] [6] [ALPHA] [X] [x^2] [−] [1] [6] [0]
[ALPHA] [X] [+] [3] [0] [0] [EXE]



3-4 Single-Variable Statistical Graphs

- Single-variable statistical graphs are drawn in the SD2 mode ([SHIFT] [MODE] [3]). "SD2" appears on the display.
- Bar graphs and normal distribution curves can be produced as single-variable statistical graphs.
- Function graphs are also possible in the SD2 mode, so graphs of theoretical values and graphs of actual values can be overdrawn.
  **Abs and $\sqrt[3]{}$ cannot be used in the SD2 mode.*
- The maximum number of data items is identical to the number of memories. You can expand memories up to a maximum of 19. If you specify a number greater than 19, the unit automatically sets the number of memories as 19.
- Graphs are drawn with the x-coordinate as the data range and the y-coordinate as the number of items (frequency) of each data.
- The [DT] key is used for data input.
- The [CL] key is used for data correction.

■ Drawing single-variable statistical graphs

• Procedure

① Specify the SD2 mode ([SHIFT] [MODE] [3]).
② Set the range values ([Range]).
③ Expand the memory in accordance with the number of bars ([MODE] [▪] *n* [EXE]).
④ Clear the statistical memories ([SHIFT] [Scl] [EXE]).
⑤ Input data (Data [DT]).
⑥ Draw the graph.
- Bar graph ..... [Graph] [EXE]
- Normal distribution curve ..... [Graph] [SHIFT] [Line] 1 [EXE]

**Data input method in step 5 is the same as that for standard deviation calculations (see page 63).*

Example **Use the following data to draw a ranked graph.**

Rank No.	1	2	3	4	5	6	7	8	9	10	11
Rank	0	10	20	30	40	50	60	70	80	90	100
Frequency	1	3	2	2	3	5	6	8	15	9	2

Perform graph preparation in accordance with the following procedure:

①Specify the SD2 mode ([SHIFT] [MODE] [3]).

②Set the range values.

The highest value to be plotted on the *x*-axis is 100, but for graphing purposes the maximum value (Xmax) is set at 110. (The general rule is that the minimum value should be equal to or greater than the minimum range value and the maximum value should be less than the maximum range value, so here we set the *x*-axis ranges to 0 through 110).

Ymax value is set to 20 for the *y*-axis because the maximum frequency is 15.

Xmin	: 0	Ymin	: 0
Xmax	: 110	Ymax	: 20
Xscl	: 10	Yscl	: 2

③Since the number of bars is 11(0~9, 10~19, 20~29.... 100~109), expand memories by 11.

[MODE] [•] [1] [1] [EXE]

④Clear the statistical memory.

[SHIFT] [Scl] [EXE]

⑤Input the data.

0 [DT] 10 [DT] [DT] [DT] 20 [DT] [DT] 30 [DT] [DT] 40 [DT] [DT] [DT]
50 [SHIFT] [,] 5 [DT] 60 [SHIFT] [,] 6 [DT] 70 [SHIFT] [,] 8 [DT]
80 [SHIFT] [,] 15 [DT] 90 [SHIFT] [,] 9 [DT] 100 [DT] [DT]

⑥First, draw a bar graph.

[Graph] [EXE]

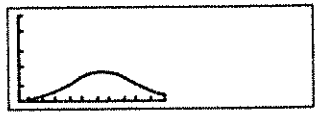
•Next, draw a normal distribution curve. Since the *y*-axis value is relatively small when compared with the bar graph, the same range values cannot be used. Change the range values to those shown below.

Xmin	: 0	Ymin	: 0
Xmax	: 110	Ymax	: 0.05
Xscl	: 10	Yscl	: 0.01

[Graph] [SHIFT] [Line] [1] [EXE]

↑

Inputting the number 1 causes a normal distribution curve to be drawn.



•Be sure to expand the memory in accordance with the number of bars. A Mem ERROR is generated if memory expansion is not performed.

•If the number of expanded memories is changed during data input, the number of data divisions also changes, thus making it impossible to produce a proper graph.

•When a value that exceeds the preset ranges is input, it is input to the statistical memory, but not into the graph memory.

•When more data than the preset *y*-axis range is input, the bar graph is drawn to the upper limit of the display, and the points outside the range cannot be connected.

•The formula used for normal distribution curves is:

$$y = \frac{1}{\sqrt{2\pi}\,\sigma} e^{-\frac{(x-m)^2}{2\sigma^2}}$$

**Keyboard designation of σ is xσn. m is x̄.*

•The following must be true in the case of range settings: Xmin < Xmax.

•After a bar graph is executed, "done" is displayed in the text display.

3-5 Paired-Variable Statistical Graphs

- Paired-variable graphs are drawn in the LR2 mode (SHIFT MODE ▤). "LR2" appears on the display.
- Paired-variable graphs can be drawn as regression lines.
- Standard function graphs can also be drawn in the LR2 mode, so theoretical graphs, data distribution and regression line graphs can be overdrawn.
- After data input in the LR2 mode, points are displayed immediately, and data is input to the statistical memory.
- When a value that exceeds the preset range is input, it is input to the statistical memory, but the point is not displayed.
- Data is input using the DT key in the following format: x data SHIFT , y data SHIFT ; frequency DT.
- The CL key is used to edit data after input is complete, but points that are produced on the display are not cleared. (Point appears even when data is corrected by the CL key).
- Points on the display cannot be retrieved if the display is cleared (SHIFT Cls EXE).

■Drawing paired-variable statistical graphs

•Procedure

① Specify the LR2 mode (SHIFT MODE ▤).
② Set the range values (Range).
③ Clear the statistical memory (SHIFT Scl EXE).
④ Input data (x data SHIFT , y data SHIFT ; frequency DT).
⑤ Draw the graph (Graph SHIFT Line 1 EXE).

**Data input method in step 4 is the same as that for Regression calculation (page 65).*

Example **Perform linear regression on the following data and draw a regression line graph.**

x_i	y_i
−9	−2
−5	−1
−3	2
1	3
4	5
7	8

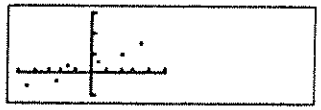
① Specify the LR2 mode (SHIFT MODE ▤).
② Set the range values to those shown in the table.

Xmin	: −10	Ymin	: −5
Xmax	: 10	Ymax	: 15
Xscl	: 2	Yscl	: 5

**According to the general rule of the x-axis range values, the values for x are: $-10 \leqq x < 10$.*

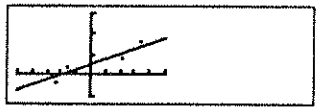
③ Clear the statistical memories.
SHIFT Scl EXE
④ Input the data.

SHIFT (−) 9 SHIFT , SHIFT (−) 2 DT
SHIFT (−) 5 SHIFT , SHIFT (−) 1 DT
SHIFT (−) 3 SHIFT , 2 DT
1 SHIFT , 3 DT
4 SHIFT , 5 DT
7 SHIFT , 8 DT



⑤ Draw the graph.

Graph SHIFT Line 1 EXE



**When data is input that is outside of the preset range values, a point does not appear.*
**An Ma ERROR is generated when there is no data input and the following key operation is performed: Graph SHIFT Line 1 EXE.*
**The following must be true in the case of range settings: Xmin < Xmax.*

Appendix

Function Reference
Error Message Table
Input Ranges of Functions
Specifications

Function Reference

Mode specification	COMP Mode (MODE 1)	Four arithmetic and function calculations.
	BASE-N Mode (MODE 2)	Binary, octal, decimal, hexadecimal conversions and calculations, logical operations.
	SD1 Mode (MODE 3)	Standard deviation calculations (1-variable statistical).
	LR1 Mode (MODE 4)	Regression calculations (paired variable statistical).
	SD2 Mode (SHIFT MODE 3)	For production of single variable statistical graphs. (Bar graphs, normal distribution curves)
	LR2 Mode (SHIFT MODE 4)	For production of paired variable statistical graphs. (Regression lines)
Functions	Type A functions	Function command input immediately after numeric value. [x^2, x^{-1}, xf, °, ʳ, ᵍ, ° ' "]
	Type B functions	Function command input immediately before numeric value. (sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, log, ln, e^x, 10^x, $\sqrt{}$, $\sqrt[3]{}$, Abs, etc.)
	Paired variable functions	Function command input between two numeric values. Numeric value enclosed in parentheses input immediately after function command. (A x^y B (A to the Bth power), B $\sqrt[x]{}$ A (A to the 1/Bth power), Pol (A, B), Rec (A, B)) **A and B are numeric values.*
	Immediately executed functions	Displayed value changed with each press of a key. [ENG, $\overleftarrow{\text{ENG}}$, $\overleftarrow{\text{° ' "}}$]

Binary, octal, decimal, hexadecimal calculations (MODE 2)	Setting number system	Decimal ..... Dec EXE Hexadecimal ..... Hex EXE Binary ..... Bin EXE Octal ..... Oct EXE
	Number system specification	Number system for the numeric value entered immediately after can be specified regardless of the currently set number system. To specify: Decimal ..... SHIFT d Hexadecimal ..... SHIFT h Binary ..... SHIFT b Octal ..... SHIFT o
	Logical operations	Input numeric values are converted to binary and each bit is tested. Result is converted back to number system used for input, and then displayed. Not ..... Reverse of each bit and ..... Logical product of each bit or ..... Logical sum of each bit xor ..... Exclusive logical sum of each bit xnor ..... Exclusive negative logical sum of each bit
Standard deviation calculations (MODE 3)	Data clear	SHIFT Scl EXE
	Data input	Data [;frequency] DT **Frequency can be omitted.*
	Data deletion	Data [;frequency] CL **Frequency can be omitted.*
	Result display	Number of data (n) ..... ALPHA 3 (n) EXE Sum (Σx) ..... ALPHA 2 (Σx) EXE Sum of squares (Σx^2) .... ALPHA 1 (Σx^2) EXE Mean ($\bar{x}$) ..... SHIFT $\bar{x}$ EXE Population standard deviation ($x\sigma_n$) ..... SHIFT $x\sigma_n$ EXE Sample standard deviation ($x\sigma_{n-1}$) ..... SHIFT $x\sigma_{n-1}$ EXE

Regression calculations MODE ▤	Data clear	SHIFT Scl EXE
	Data input	x data, y data [;frequency] DT **Frequency can be omitted.*
	Data deletion	x data, y data [;frequency] CL **Frequency can be omitted.*
	Result display	Number of data (n) ... ALPHA 3 (n) EXE Sum of x (Σx) ..... ALPHA 2 (Σx) EXE Sum of y (Σy) ..... ALPHA 5 (Σy) EXE Sum of squares of x (Σx^2) ..... ALPHA 1 (Σx^2) EXE Sum of squares of y (Σy^2) ..... ALPHA 4 (Σy^2) EXE Sum of products of x and y (Σxy) ..... ALPHA 6 (Σxy) EXE Mean of x ($\bar{x}$) ..... SHIFT $\bar{x}$ EXE Mean of y ($\bar{y}$) ..... SHIFT $\bar{y}$ EXE Population standard deviation of x ($x\sigma_n$) ..... SHIFT $x\sigma_n$ EXE Population standard deviation of y ($y\sigma_n$) ..... SHIFT $y\sigma_n$ EXE Sample standard deviation of x ($x\sigma_{n-1}$) ..... SHIFT $x\sigma_{n-1}$ EXE Sample standard deviation of y ($y\sigma_{n-1}$) ..... SHIFT $y\sigma_{n-1}$ EXE Constant term of regression formula (A) ..... SHIFT A EXE Regression coefficient (B) ..... SHIFT B EXE Correlation coefficient (r) ..... SHIFT r EXE Estimated value of x ($\hat{x}$) ..... SHIFT $\hat{x}$ EXE Estimated value of y ($\hat{y}$) ..... SHIFT $\hat{y}$ EXE

Special functions	Ans	The latest result obtained in manual calculations is stored in memory. It is recalled by pressing Ans. **Mantissa of numeric value is 10 digits.*
	Replay	•After calculation results are obtained, the formula can be recalled by pressing either ◁ or ▷. •The replay function is not cleared even when AC is pressed or when power is turned off. •If an error is generated, pressing either ◁ or ▷ will cancel the error and the point where the error was generated will be indicated by a blinking cursor.
	Multistatement	Colons are used to join a series of statements or calculation formulas. If joined using "◢", the calculation result to that point is displayed.
	Memory	The number of memories can be expanded from the standard 26. Memories can be expanded in units of one up to 50 (for a total of 76). MODE • number of memories EXE.

Graph function	Range	Graph range settings Xmin ..... Minimum value of x Xmax ..... Maximum value of x Xscl ..... Scale of X-axis (space between points) Ymin ..... Minimum value of y Ymax ..... Maximum value of y Yscl ..... Scale of Y-axis (space between points)
	Trace	Moves pointer on graph. Current coordinate location is displayed.
	Plot	Marks pointer (blinking dot) at any coordinate on the graph display.
	Line	Connects with a straight line two points created with plot function.
	Factor	Defines factor for zoom in/zoom out.
	Zoom	Zoom × f .... Zooms in on the graph in accordance with the zoom factors Zoom × 1/f ... Zooms out on the graph in accordance with the inverse of the zoom factors Zoom Org .. Returns zoomed graph to original dimensions
	Scroll	Scrolls screen to view parts of graphs that are off the display.

Error Message Table

Message	Meaning	Countermeasure
Syn ERROR	Calculation formula contains an error.	Use ◀ or ▶ to display the point where the error was generated and correct it.
Ma ERROR	①Calculation result exceeds calculation range. ②Calculation is performed outside the input range of a function. ③Illogical operation (division by zero, etc.)	①②③ Check the input numeric value and correct it. When using memories, check that the numeric values stored in memories are correct.
Stk ERROR	•Execution of calculations that exceed the capacity of the stack for numeric values or stack for calculations.	•Simplify the formulas to keep stacks within 10 levels for the numeric values and 24 levels for the calculations. •Divide the formula into two or more parts.
Mem ERROR	•Memory expansion exceeds level of 50. •Attempt to use a memory such as Z[5] when no memory has been expanded.	•Press MODE · (Defm) to expand memory to necessary level. •Use memories within the current number of memories.
Arg ERROR	•Argument input incorrectly. Ex. Negative value input for Defm, value other than 1 ~ 9 input for n, etc.	•Re-enter argument correctly.

Input Ranges of Functions

Function	Input range	Internal digits	Accuracy	Notes
$\sin x$ $\cos x$ $\tan x$	(Deg) $\lvert x\rvert < 9\times10^{9}$° (Rad) $\lvert x\rvert < 5\times10^{7}\pi$ rad (Gra) $\lvert x\rvert < 1\times10^{10}$ grad	12 digits	As a rule, accuracy is ±1 at the 10th digit.	However, for tan x: $\lvert x\rvert \neq 90(2n+1)$: Deg $\lvert x\rvert \neq \pi/2(2n+1)$: Rad $\lvert x\rvert \neq 100(2n+1)$: Gra
$\sin^{-1}x$ $\cos^{-1}x$	$\lvert x\rvert \leqq 1$	"	"	
$\tan^{-1}x$	$\lvert x\rvert < 1\times10^{100}$			
$\sinh x$ $\cosh x$	$\lvert x\rvert \leqq 230.2585092$	"	"	Note: For sinh and tanh, when $x=0$, errors are cumulative and accuracy is affected at a certain point.
$\tanh x$	$\lvert x\rvert < 1\times10^{100}$			
$\sinh^{-1}x$	$\lvert x\rvert < 5\times10^{99}$	"	"	
$\cosh^{-1}x$	$1 \leqq x < 5\times10^{99}$			
$\tanh^{-1}x$	$\lvert x\rvert < 1$			
$\log x$ $\ln x$	$1\times10^{-99} \leqq x < 1\times10^{100}$	"	"	
10^{x}	$-1\times10^{100} < x < 100$	"	"	
e^{x}	$-1\times10^{100} < x \leqq 230.2585092$			
$\sqrt{x}$	$0 \leqq x < 1\times10^{100}$	"	"	
x^{2}	$\lvert x\rvert < 1\times10^{50}$			
$1/x$	$\lvert x\rvert < 1\times10^{100}$, $x \neq 0$	"	"	
$\sqrt[3]{x}$	$\lvert x\rvert < 1\times10^{100}$			
$x!$	$0 \leqq x \leqq 69$ (x is an Integer)	"	"	

Function	Input range	Internal digits	Accuracy	Notes
Pol (x,y)	$\sqrt{x^2+y^2} < 1\times10^{100}$	12 digits	As a rule, accuracy is ±1 at the 10th digit.	
Rec (r,θ)	$0 \leqq r < 1\times10^{100}$ (Deg) $\lvert\theta\rvert < 9\times10^{9}$° (Rad) $\lvert\theta\rvert < 5\times10^{7}\pi$ rad (Gra) $\lvert\theta\rvert < 1\times10^{10}$ grad	"	"	However, for tan θ: $\lvert\theta\rvert \neq 90(2n+1)$: Deg $\lvert\theta\rvert \neq \pi/2(2n+1)$: Rad $\lvert\theta\rvert \neq 100(2n+1)$: Gra
°' "	$\lvert a\rvert$, b, $c < 1\times10^{100}$ $0 \leqq$ b, c	"	"	
$\overleftarrow{\text{°' "}}$	$\lvert x\rvert < 2.777777777\times10^{96}$ Hexadecimal display: $\lvert x\rvert \leqq 2777777.777$			
x^{y}	$x>0$: $-1\times10^{100} < y\log x < 100$ $x=0$: $y>0$ $x<0$: $y=n$, $\frac{1}{2n+1}$ (n is an integer) However; $-1\times10^{100} < \frac{1}{y}\log\lvert x\rvert < 100$	"	"	
$\sqrt[x]{y}$	$y>0$: $x \neq 0$ $-1\times10^{100} < \frac{1}{x}\log y < 100$ $y=0$: $x>0$ $y<0$: $x=2n+1$, $\frac{1}{n}$ ($n \neq 0$, n is an integer) However; $-1\times10^{100} < \frac{1}{x}\log\lvert y\rvert < 100$	"	"	

Function	Input range	Internal digits	Accuracy
$a^b/_c$	•Results Total of integer, numerator and denominator must be within 10 digits (includes division marks). •Input Result displayed as a fraction for integer when integer, numerator and denominator are less than 1×10^{10}.	12 digits	As a rule, accuracy is ±1 at the 10th digit.
SD (LR)	$\|x\|<1\times10^{50}$ $\|y\|<1\times10^{50}$ $\|n\|<1\times10^{100}$ $x\sigma_n$, $y\sigma_n$, $\bar{x}$, $\bar{y}$, A, B, r: $n\neq0$ $x\sigma_{n-1}$, $y\sigma_{n-1}$: $n\neq0, 1$	"	"

Function	Input range
BASE-N	Values after variable within following range: Dec: $-2147483648 \leqq x \leqq 2147483647$ Bin: $1000000000 \leqq x \leqq 1111111111$ (negative) $0 \leqq x \leqq 011111111111$ (0, positive) Oct: $20000000000 \leqq x \leqq 37777777777$ (negative) $0 \leqq x \leqq 17777777777$ (0, positive) Hex: $80000000 \leqq x \leqq$ FFFFFFFF (negative) $0 \leqq x \leqq$ 7FFFFFFF (0, positive)

*Errors may be cumulative with internal continuous calculations such as x^y, $\sqrt[x]{y}$, $x!$, $\sqrt[3]{x}$ sometimes affecting accuracy.

Specifications

Model: fx-6200G

Graph functions

Built-in function graphs: (20 types) sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, log, ln, 10^x, e^x, x^2, $\sqrt{\ }$, $\sqrt[3]{\ }$, x^{-1}

Types of graphs: User generated function graphs
Rectangular coordinates
Single-variable statistics: bar graphs, normal distribution curves
Paired-variable statistics: regression lines

Graph functions: Range specification, Overdraw, Trace, Zoom (×f, ×1/f, factor, original (resumé)), Plot, Line, Scroll

Calculations

Basic calculation functions: Negative numbers, exponents, parenthetical addition/subtraction/multiplication/division (with priority sequence judgement function — true algebraic logic).

Built-in scientific functions: Trigonometric/inverse trigonometric functions (units of angular measurement: degrees, radians, grads), hyperbolic/inverse hyperbolic functions, logarithmic/exponential functions, reciprocals, factorials, square roots, cube roots, powers, roots, squares, decimal-sexagesimal conversions, binary-octal-hexadecimal calculations, coordinate transformations, π, random numbers, absolute values.

Statistics: Standard deviation — number of data, sum, sum of squares, mean, standard deviation (two types).
Linear regression — number of data, sum of x, sum of y, sum of squares of x, sum of squares of y, mean of x, mean of y, standard deviation of x (two types), standard deviation of y (two types), constant term, regression coefficient, correlation coefficient, estimated value of x, estimated value of y.

Special functions:	Insert, delete, replay functions, multistatement (: and ◢).
Memories:	26 standard (maximum 76), Ans memory
Calculation range:	$\pm 1 \times 10^{-99} \sim \pm 9.999999999 \times 10^{99}$ and 0. Internal operation uses 12-digit mantissa.
Rounding:	Performed according to the specified number of significant digits or the number of specified decimal places.
Exponential display:	Norm 1 — $10^{-2} > \|x\|,\ \|x\| \geqq 10^{10}$ Norm 2 — $10^{-9} > \|x\|,\ \|x\| \geqq 10^{10}$

General

Power supply:	Two lithium batteries (CR2032)
Power consumption:	0.009 W
Battery life:	Approximately 350 hours on CR2032
Auto power off:	Power is automatically switched off approximately 6 minutes after last operation.
Ambient temperature range:	0°C ~ 40°C (32°F ~ 104°F)
Dimensions:	9.9mmH × 73mmW × 141.5mmD (3/8"H × 2 7/8"W × 5 1/2"D)
Weight:	84g (2.9oz) including batteries

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